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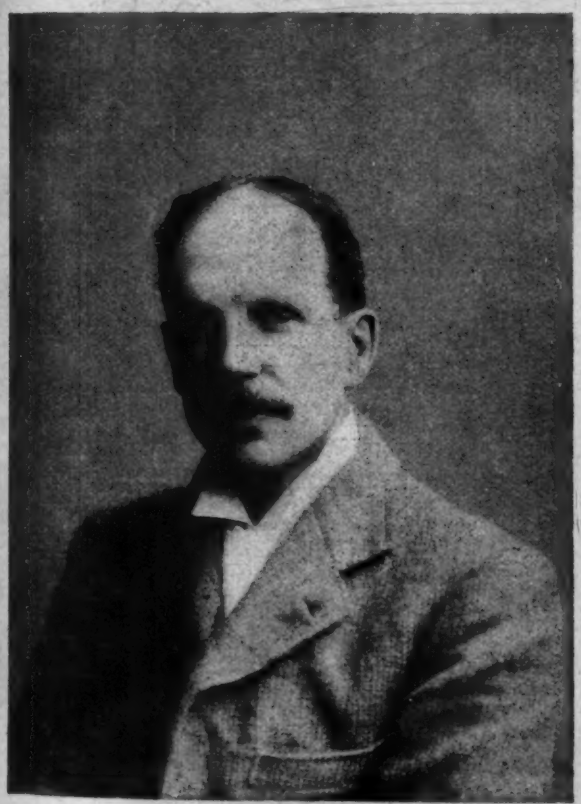

WELL-KNOWN TEACHERS AT WORK: MR. C. F. HAYWARD.

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·VOL· XXI No. 4

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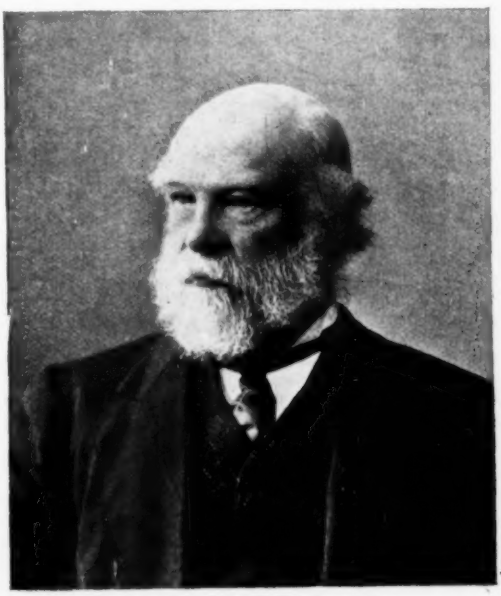
THE BRITISH ASSOCIATION AT BRADFORD.

BY OUR OWN CORRESPONDENT.

THE great annual scientific congress has again been held, the scene of this year's proceedings having been laid in Yorkshire, a district which has not been visited since 1890, when the meeting was held at Leeds. The president for the year was Sir William Turner, the venerable Professor of Anatomy in the University of Edinburgh. Short, stout, and sturdy in person, with white hair and beard, Sir William hardly appears the typical Scotch professor; but he possesses the Scotch facility of adapting himself to all positions, even the most difficult, and he showed himself at Bradford one of the most capable and one of the most popular presidents of recent years. Sir William Turner is well worthy of the honour conferred upon him by his brethren; his record of honours is almost unrivalled. He was elected to the Fellowship of the Royal Society in 1886, before which time he was already the author of numerous memoirs on subjects connected with human and comparative anatomy. He has held the chair of Anatomy in Edinburgh University since 1867; has been a member of the General Medical Council since 1873; and became the president of that august body in 1898. Few men of science have received such recognition at the hands of other universities than his own. He has received the honorary degree of Doctor in one or other faculty from Glasgow, Oxford, Dublin, Durham, Cambridge, Montreal, and Toronto. He is, besides, D.Sc. of Edinburgh and M.B. of London. Besides writing the memoirs already mentioned, he is known to the scientific world as the author of several reports in the publications of H.M.S. *Challenger*. A worthy successor this to Sir Michael Foster!



SIR WILLIAM TURNER.

The meetings of the Association in Bradford have been most admirably arranged and conducted; the kindness and hospitality of the citizens, and the skill with which everything has been conducted, make the meeting stand out conspicuously among those of recent years.

The President's address was based upon biological research, and treated exhaustively of the cell as the unit of construction of both plants and animals, together with the connection between cellular structure and physiological function. It was hardly of such general interest as have been those of some of his predecessors, dealing as it did with very specialised structures. It was, however, very well received by a very large gathering of the members of the Association.

The work of the several sections into which the Association is divided has been of the most varied character, but perhaps may be said to have been characterised this year by more utilitarian features than has usually been the case. Many

subjects of great practical importance have been ventilated, and the reports of much research laid before the public. The more theoretical and speculative side has not, however, been neglected.

Malaria and Mosquitoes.—One of the most important communications made to the biological section was the outcome of the commission to which was entrusted the duty of investigating the true nature of malarial fever. Major Ross made it the subject of what was practically a lecture in Section D. He said that the fever had been proved to be caused by a peculiar parasite which occurs in the blood, and which belongs to the Sporozoa; and he gave a detailed account of its curious life-history. The organism can reproduce itself freely by ordinary fission, but it exhibits a much more complicated process, which is connected with the spread of the disease. At one stage in the development of the organism a very minute thread sprouts out from the side of a particular cell, and is soon cast loose. It fuses with another cell, and as the result of the fusion a very large number of somewhat similar thread-like cells are formed in the interior of the latter. At a certain stage of maturity this cell bursts, and the threads are set free in the blood of the patient. This rupture of the cell and the scattering of the threads are accompanied by the liberation of a peculiar toxin, and simultaneously the fever sets in. Then follows shivering, and ultimately a sweating stage, during which the patient gets rid of the toxin. The threads give rise subsequently to spores, and the whole process then goes on again. Hence we have the well-known periodicity of malarial fever. The transmission of the disease from one body to another depends upon the transport of these thread-like cells or *blastocytes*, and in this connection lies the danger of the mosquito. If one of these insects bites a patient suffering from malarial fever, it sucks up into its stomach some of these blastocytes, which continue to multiply there, and eventually penetrate its wall, and are received into the tissues of the mosquito, in the juices of which they again undergo multiplication. The insect becomes thus permeated by these blastocytes. When a person is bitten, some of these thread-like cells are deposited in his blood, and so the disease is communicated to him. A curious incident in the life-history of the insect is that the parasite cannot develop in it unless it is fed on blood. When it is nourished only with bananas, it remains healthy. Major Ross pointed out that there are two forms of mosquitoes found in England which are capable of carrying the disease, but owing to the rareness with which the parasite itself occurs here, it is very difficult for the insect to become infected. He pointed out also that the method of reducing the prevalence of malarial fever in Africa must be to reduce or destroy the places for the growth of the larvæ of the mosquitoes by a proper system of surface drainage.

British Wood Supply.—A communication on British Sylviculture was read to Section K by Mr. Samuel Margerison, who somewhat startled his hearers by attacking the quality of British oak. He showed by statistics that though our timber is deficient as well in quantity as in quality, there is quite sufficient waste land in Great Britain to produce all the oak we need. With improved methods of culture, forests in Germany have been made to produce three or four times the amount of timber grown on our shores. Our landowners are, however, apathetic, and with us sylviculture is subservient to sport. The matter calls for financial aid from the Government, and the appointment of a department devoted to forestry. On the Continent, improved results are obtained by thick planting and careful thinning, ensuring an overhead canopy. The author also discussed in some detail the cost of transport and methods of carrying timber, showing how severely these matters handicapped the trade in wood. In the discussion that followed, Professor Balfour of Edinburgh called attention to the necessity for improved education for the actual foresters, and said he saw no reason why, under improved conditions, we should not grow all our own soft timber.

Smoke and Vegetation.—Another subject of great practical importance brought before the same section was the great smoke-cloud of the manufacturing districts, and its effect upon the vegetable life of the affected region. This was introduced by Mr. Albert Wilson, who claimed that the widespread effect of the smoke-cloud in reducing air transparency and sunshine, and thereby modifying temperature and influencing animal and plant life, has been very inadequately realised. He stated that the great smoke drift from South and East Lancashire can be seen crossing over the Pennine range of moorlands, and then mingling with the West Riding smoke, making the view to the south-east very limited. Observed from North Lancashire and Westmoreland, the smoke of South and East Lancashire is well marked with south winds, as is also that of West Yorkshire with south-east winds. Over the large tract of country north of the great smoke area the atmosphere is never brilliant with south winds, and there is no doubt that the smoke is taken as far as Scotland. The smoke from Barrow-in-Furness, as seen from the hills above Lancaster, with west winds, can be watched as a great band rising from the chimneys and furnaces away across Morecambe Bay and driving inland near to Carnforth. As a result of this enormous production, the rain which falls in the large towns is often considerably discoloured, and examples of "black rain," at considerable distances from large towns, are well known. The great exhalation of smoke is associated quite distinctly with the black fogs which occur during calms and anticyclonic weather. The combined effects of the fog itself, and the low temperatures which it induces, are very marked upon the character of the vegetation. The effect of smoke is much more pronounced on the lower than on the higher forms of plants, and it is not surprising to find a large diminution during the last forty years in the abundance and luxuriance of mosses and liverworts in the regions round the large towns, some species formerly common having become rare or unknown. Plants growing on the barks of trees are particularly affected, being exposed in a very special manner to its influence. The twigs and branches become covered with a grimy mixture of water and tarry matter, in which there is a certain admixture of sulphuric acid, which spreads over the delicate plants growing on the bark and destroys them.

Earthquakes.—A very interesting address was given by Mr. John Milne on the large earthquakes recorded in 1899. In his observatory at Shide, in the Isle of Wight, one hundred and thirty earthquakes were recorded, the greater number of which were also observed at Kew, while very many of them were common to registers from Canada, the Cape of Good Hope, India, Java, Japan, and other distant countries. Analysis of these records has increased our knowledge respecting the rates at which motion is transmitted through our world, and indirectly thrown new light upon its rigidity. The arcual velocity of surface has been investigated, and new rules, based on these investigations, have been formulated for determining the position of earthquake origins. It has been shown that the distance of an origin from a given station can be determined either from the interval by which the preliminary tremors outrace the larger surface waves, or from the interval between the arrivals of waves which have travelled from their origin round the world in different directions.

The Origin of the Art of Writing.—A paper in the Anthropological section on this subject was of very great interest. It was contributed by Mr. Arthur Evans, and dealt especially with his excavations in the Mycenæan Palace of Knosses. In that great prehistoric building, the latest elements of which can hardly be brought down later than the thirteenth century B.C., there came to light a series of deposits of clay archives inscribed both with hieroglyphics and a new system of linear writing. Those of the hieroglyphic class, though apparently contemporary with the other, were less numerous, and were found in a separate magazine. These pictographic signs might be said to form an illustrated history of Cretan culture in Mycenæan times. The obviously ideographic or determinative character of some of the hieroglyphics gives a clue to the meaning of many of the tablets. Many of the latter are accounts, as is shown by the presence of various numeral signs, but the form of numeration still presents points of obscurity. The hieroglyphic script itself shows a certain parallelism with the Hittite inscriptions of Northern Syria. Its beginnings can be traced very far back on Cretan soil, and it unquestionably represents the writing

BRITISH MUSEUM

of the indigenous Cretan stock, the Eteocretans of the *Odyssey*. The great bulk of these clay records, however, exhibit a linear style of writing fundamentally different from that of the hieroglyphic class, and far ahead of it in development. The tablets present some likeness to the Babylonian tablets, and the inscription is divided by horizontal lines. The letters are of a free upright European character, and number about seventy. Of these, ten show resemblances to the later Greek, and the same number to the Cypriote syllabary. About the same number of forms are also common to the hieroglyphic Cretan series. The letters seem to have been for the most part syllabic; lines of division appear between the words, and the writing runs consistently from left to right. In some cases the pictorial origin of the letters may be traced. A certain number are unquestionably ideographic. Others represent measures and quantities, and are always associated with numerals. A decimal system of numeration was employed, somewhat resembling the Egyptian. These discoveries not only carry back the existence of written documents on Greek soil some eight centuries before the first known muniments of Greek writing, and five before the earliest Phœnician, as exhibited in the Moabite stone, but they afford a wholly new standpoint for investigating the origin of the alphabet.

The Origin of Coal.—A very interesting discussion took place upon this subject in the department of geology, both botanists and geologists taking part in it. The geological position was set out by Mr. Strahan, who put before the section the geologist's explanation of the physical conditions which led to the growth and development of the flora concerned. He said that the early view of the origin of coal was that it was formed of vegetable matter drifted beyond the region to which the finest mineral sediment could reach. More minute examination of the strata, however, revealed proofs of land surfaces in the coal measures, and it was then generally accepted that the coal seams represented forests in the place of their growth. The evidence in favour of this conclusion is fivefold. 1. Rain-pittings, sun-cracks, and footprints prove that the surfaces of some of the beds were exposed to the air. 2. Erect tree-trunks of large size, in some cases attached to large spreading roots, are not uncommon. Land shells, millipedes, and the skeletons of air-breathing reptiles have occasionally been found within the hollow trunks. 3. The under clays of coal seams are traversed in all directions by branching rootlets, unlike the drifted fragments in the bedding planes of the other strata. They were described as an invariable accompaniment of coals, and as being the soils in which the coal forest was rooted. 4. Coal seams with thin minute partings persist over vast areas, and it was thought impossible that so wide and regular a distribution of the vegetable matter could have been accomplished by drifting. 5. The chemical composition of the coals was believed to prove that the vegetable matter underwent partial decomposition in the open air before being submerged or buried. Mr. Strahan, however, considered the evidence inconclusive, and criticised all five of the points relied on. The chief botanical contributor to the discussion was Mr. Seward, F.R.S., who set before the section the climatic and other physical conditions under which coal was formed. He said it was usually stated that the climate during the formation of the coal measures was uniform, but differences between the plants found in the coal beds of the northern and southern hemispheres showed, he thought, that this was not true. He remarked that some of the ferns found in coal resembled epiphytes, which grew on the trunks of trees, though not as parasites. It was also found that coal plants were structurally similar to those plants of modern times which grow in strong sunlight. Another noteworthy feature in plants of the coal measures was the absence of the annual rings of growth, which pointed to an equable climate during growth, and to adaptations for the storage of water. In connection with the latter fact, we find that plants growing in salt marshes possess this peculiarity, in which also they resemble desert plants. Other facts show that the supposed extraordinarily rapid growth of coal plants is doubtful. The general trend of evidence goes to show that those plants grew in swamps or marshes, and not on dry land. Mr. Seward thought that there was a good deal to be said in favour of the view that they grew on the borders of lakes, and were carried down to where they have been found by water action. He called attention to the fact also that in many masses of coal these remains of large plants do not occur, and that the type of vegetation abounding in such seams was probably some small alga.

The meeting was brought to a conclusion on Wednesday, September 13. At a meeting of the General Committee, Professor Rücker was elected to be president at the meeting in Glasgow in 1901, and the date of the meeting was fixed for September 11. Belfast sent an invitation for the Association to visit that town in 1902, and it was accepted. Professor Schäfer, who has filled the office of general secretary for the past five years with Sir W. Roberts-Austin, retired from the secretariat, and Dr. D. H. Scott, F.R.S., the honorary director of the Jodrell Laboratory, Kew Gardens, was elected to succeed him.

THE PRACTICAL TEACHER AT PARIS.

THE "CONGRÈS INTERNATIONAL DE L'ENSEIGNEMENT SECONDAIRE."

BY OUR SPECIAL CORRESPONDENT, MONS. P. MIEILLE OF TARBES.

"*LES questions d'enseignement sont des questions sociales.*" says the distinguished writer M. Max Leclerc, the present head of one of the eminent publishing houses of Europe—namely, MM. Armand Colin and Co., Paris—in his prefatory report to the committee of the Congress. No words could more adequately express the paramount importance and vast significance of these international gatherings of members of the profession.

The three hundred secondary teachers, French *agrégés*, English graduates, German doctors, etc., etc., that assembled within the precincts of our ancient Sorbonne for the discussion of the programme of the *Congrès*, were one and all duly impressed with the deep sense of their social responsibilities. The empiric and happy-go-lucky kind of organisation of education that prevailed in the past, and still prevails to a certain extent in most countries—Germany perhaps excepted—is no longer in accordance with the scientific spirit of the age, and constitutes a serious danger for the modern world.

That reform is necessary, that the conditions of modern life require a more careful adaptation of the means to the end—the true scope of all education—no one present was disposed to gainsay. And to the question, "*Quel est le rôle social de l'enseignement secondaire?*" the answer was unanimous, in spite of the national and racial characteristics that differentiate the practical application of an otherwise common conception of secondary education.

But for the convenience of my English readers, I think I had better give a summary of the general programme of the *Congrès*.

The questions were few; and so happy were the committee of organisation in their choice of the *rapporteurs*, that every member could, by merely perusing the little pamphlet, including all the preliminary reports, not only get a sufficient acquaintance with all the subjects under discussion, but, moreover, get a mine of most suggestive information on all points concerned.

The following was the programme:—

1. Rôle social de l'enseignement secondaire.
2. De l'autonomie des etablissements d'enseignement secondaire et de la diversité des méthodes.
3. Extension universitaire.
4. Dans quelle mesure, en quel sens, et par quels moyens convient-il de développer la personnalité des élèves en leur initiative?
5. La formation des maîtres de l'enseignement secondaire.

6. Du rôle des professeurs hommes et des professeurs femmes dans l'enseignement des garçons et dans celui des jeunes filles.
7. Complément pratique de l'education morale des jeunes filles dans les lycées. Patronage d'enfants par des jeunes filles.
8. De la Correspondance Interscolaire Internationale.

The *Congrès* opened on July 31, and was closed by the Minister of Public Instruction, M. G. Leygues, on the fifth of August.

As I have already mentioned, the report of M. Max Leclerc on the "Social Rôle of Secondary Instruction" came first under discussion.

Many of our distinguished foreign guests took a leading part in the debates, most of them in excellent French—Mr. Lyulph Stanley and Mr. Fabian Ware showing themselves excellent French scholars, as well as liberal and open-minded educators.

It might be somewhat wearisome, even to the best disposed reader, to be carried through a long string of votes and resolutions. I shall therefore content myself with setting forth my impressions, *au jour le jour*, as I gather them from my notes.

One of the things that most impressed me from the very first was the unfailing courtesy and kindliness of the audience in listening to and cheering the numerous orators who succeeded one another during the sittings. I was also struck by the general fluency of speech shown by many of the professors present. Some seemed to the manner born; and though there were others painfully conscious of having to fulfil a duty, the generality spoke, as it were, with their hands in their pockets.

I must say here that I felt proud, as a Frenchman, of the way in which the president and vice-presidents of the bureau, MM. Croiset, Jalliffet, and Emile Gautier, conducted the debates. The lucid summing-up of President Croiset, the unfailing courtesy of his remarks, and the precision of his presidential addresses, made of every sitting a kind of intellectual treat. It is only just to add that he was very ably seconded and assisted by the whole bureau.

The first question, precisely on account of its international character and bearings, gave rise to the most lively discussion. I noted, in particular, a remarkable saying of M. Max Leclerc to the effect that, considering a nation in the light of an army, the exact *rôle* of secondary instruction should be to form the officers of such an army, social, political, industrial, commercial, etc. The thing to be avoided is the over-production of officer-candidates. In France this surplus exists, and is fast becoming a danger. The *déclassés*, as we call those officers who have no military command, and are, by the very fault of their secondary instruction, incapacitated from being good and useful privates or even non-commissioned officers, form one of the most complex problems of the hour.

The comparison of the different systems of *enseignement secondaire* among the different peoples was fruitful of very suggestive and ingenious *rapprochements*, from which many practical hints could be got for reform or improvement.

If we envy the British their natural autonomy and self-government, if I may use the word, of your public and middle-class schools, they, in their turn, may profit by the study of our central organisation. Our system of state supervision and inspection has many good points, and may offer a model to be imitated, if not exactly to be copied.

The much-vexed question of modern as opposed to classical culture was extensively treated in several interesting French and foreign memoirs, with the following conclusion—namely, that the so-called classical culture, if not reserved to an *élite* (a fast-waning *élite*, by-the-bye), must compromise with the utilitarian spirit of the age, and get out of the obsolete methods of the past generations. Modern culture—that is, classical culture by and from modern literature, and the exclusion of Latin and Greek—was very ably defended. The general vote adopted it as the culture *par excellence* for the middle classes, and as a transition towards the raising of the standard of elementary instruction.

Mr. Henry Bérenger, the author of the report on "University Extension," advocated with impassioned eloquence "integral education" for all children alike, and to begin with the utter suppression of the conventional barriers that separate the three orders of teaching and teachers: *primaire, secondaire, supérieur*. The example of Scotland, Switzerland, Norway, the United States, etc., was called to witness the practicability and good results of such a fusion of the pedagogical world.

As M. Bérenger pointed out, the movement that has led to the methodical organisation of "*l'enseignement secondaire du peuple*" was practically unknown outside England ten years ago. To England and the University of Cambridge is due the honour of having dealt so beneficially and practically with the great problem of the people's education. Thanks to the works of Max Leclerc and F. Buissoy, the Sorbonne professor, France has taken up the movement of university extension, and within the last two or three years a certain number of *universités populaires* have been opened in Paris and the large provincial towns.

The *Congrès* had to study some of the problems raised by the welcome everywhere granted by the people to the *universités populaires*, and the following were among the questions discussed:—"The respective rôle of university and secondary professors in university extension; the organisation of the lectures and lessons in large cities, in industrial towns, in the agricultural centres; state protection and supervision of the movement, and especially of the freedom of action of its teachers; and lastly, of the gratuity of the lessons and lectures."

The discussion took place at a meeting open to the professors of the two orders, *secondaire et supérieur*, and was permeated throughout with the most generous spirit of progress and, I may go so far as to say, of self-sacrifice on the part of every member of congress. I shall mention no names, but I can assure my readers that all the orators—English, French, Germans, Italians, etc., etc.—vied with one another in their zeal for the sacred cause of the education of the people. The audience were at one in their enthusiastic response to the call of duty, so that I could not help asking myself where might those disdainful and "stuck-up" *intellectuels* be found among our number, of whom we hear so much as the sworn foes of free action and free thought. There seemed to be not one among the *élite* of the world's teachers who was not ready, eager even, to come down from his high speculations, his sanctuary of books, or his peaceful study, to mingle with the people, to share with the toiling millions the manna of science and literature, to make them partake of that feast of the soul, the intellectual food without which, it has been said, mere earthly bread is insufficient nourishment.

About the "formation" of secondary teachers there was a lively, although courteous, "passage of arms" between the reformers and the *laudatores temporis acti*. Is not a course of technical—in the present case pedagogical—instruction indispensable to the would-be teacher? was the question to be discussed.

At first sight it seems there is only one possible answer. As among us, for instance, the would-be engineer goes through a practical course of engineering before he has anything to do with engines, so the would-be master should go through a practical course of pedagogy before he is trusted with the charge of children's education. This seems an elementary, simple truth. And yet the general practice in France and in some other countries, England included, points to a quite different conclusion. (This remark and the following must be understood as relating to secondary teaching alone.) From the discussion at the *Congrès*, it was clearly shown that a good many secondary masters—English B.A.'s or M.A.'s, French *licenciés* and *agrégés*—enter the teaching profession with a degree, but with no technical or practical knowledge whatever of pedagogy. How is that? A kind of explanation was given us by a very clever young *agrégé*, who—I thought of the man that puts an old candle in a new lantern—frankly professed his disdain and mistrust of pedagogy. To form us, he said, there is first our vocation, and secondly, practice.

I am bound to say that, despite his cleverness, this young champion of the old lady "routine" failed to convince the audience. His assumption that teachers are "born, not

made" was accepted *cum grano salis;* and to his belief in the *fit fabricando faber* some one rightly objected that, whereas a smith may improve his knowledge of his trade by the spoiling of many a horse-shoe, the master cannot well incur the risk of spoiling many a pupil, even were he to turn them out to perfection ever afterwards.

The prejudice against pedagogy is not, judging from what we heard at the *Congrès*, confined to Frenchmen. The "Varsity" fellows of every country, England not excepted, I think, are liable to put rather too much trust in the exclusive "virtue" of a purely classical training for the fitting of any good scholar to the teaching profession. Yet, outside theory of every kind, facts are there to prove that even the most gifted of men must learn their trade. If engineering has to be learned, why not that finer kind of engineering that turns out men instead of machines?

Hence we must recognise the necessity of a pedagogical training for the future masters of secondary schools. Such training may be given in different ways: in special colleges; by means of a course of pedagogical lectures at the university; through an apprenticeship of the future master in a high-class public school, etc. The *Congrès*, while recognising the absolute want of such a technical training for the masters of secondary schools, could not and would not solve the question of "ways and means." That is left to the proper initiative of governments, or of the universities themselves.

It is but right to add that several orators did full justice to the spirit of progress and reform that signalises in the matter of training, as in many others, the body of teachers of elementary schools.

Mdlle. Dugard, of the Lycée Molière in Paris, presented the report on the sixth question of the programme. Several foreign memoirs were also read on the same subject, and the discussion was well supplied with precise statements and authoritative facts. That a more harmonious *collaboration* of men and women teachers is desirable, no one seemed disposed to deny. That women ought to be employed more extensively in the education of the younger boys, up to ten or twelve years of age, was agreed upon unanimously. But some demurred when it came to be asked whether men might not with advantage teach the girls from fifteen or sixteen years upwards. The example of the United States, Switzerland, Norway, Denmark, Germany, Scotland to a certain extent, where lady teachers teach boys with the most excellent results, was brought in with good effect, and certainly influenced the final vote. For in spite of a certain amount of prejudice and even reluctance, a resolution tending towards the adoption of Mdlle. Dugard's conclusions was victoriously passed.

The following is the conclusion voted upon. I give it in full, as it will not fail to interest the lady readers of THE PRACTICAL TEACHER.

"En résumé, assurer à l'enseignement des jeunes filles vers la quatorzième année, la collaboration des professeurs hommes et à l'enseignement des garçons celle des professeurs femmes, bien au delà de la première enfance, tel nous paraît être un progrès auquel les maîtres du 20e siècle devront travailler."

Such is the solution I for one have been trying to hammer into the head of my contemporaries as the right one, and I earnestly hope that the vote of the *Congrès* will ensure its adoption.

The last question the *Congrès* had to deal with was that of international correspondence. The very able and exhaustive report of Mdlle. Scott, of the Lycée Molière, procured for international correspondence the warmest and I think I may add the most enthusiastic reception. The names of the founders and initiators, among which came that of our editor and friend, M. Scheurmier, were heard with kindest applause; and a resolution, commending international correspondence to the good will and care of all the Education Departments, was voted by all present. The Minister of Public Instruction, M. Leygues, had sent his *chef de cabinet*, Professor Déjean, expressly to give him an account of the discussion, and I was honoured with the official congratulations of that gentleman. I had also the satisfaction of seeing won over to the good cause of international concord no less a person than the Hon. Bruce of the Education Department. I had the honour of meeting him again at M. Stead's, and he was kind enough to express once more his interest in the scheme, and his readiness to endeavour to promote its introduction into English schools.

But I am afraid I have tired out even such indulgent readers as my colleagues of THE PRACTICAL TEACHER. Yet, before taking my leave of them, I must ask their kind indulgence for a third paper, which will appear next month, and will contain an account of the *Congrès* of elementary teachers.

WELL-KNOWN TEACHERS AT WORK.

MR. C. F. HAYWARD,

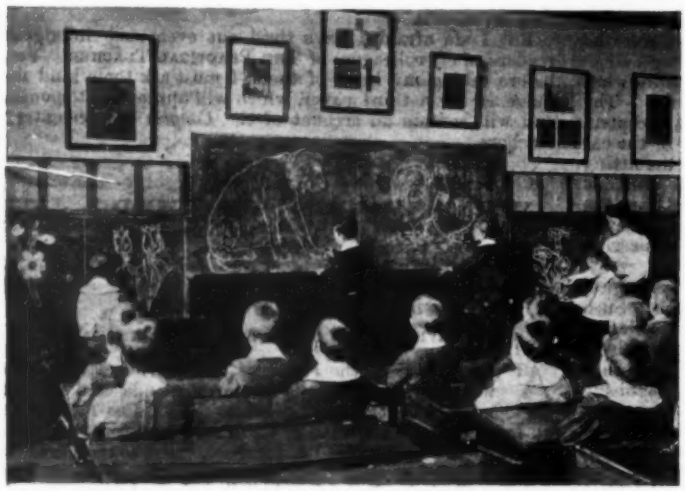
SOMERVILLE ROAD BOARD SCHOOL, BIRMINGHAM.

AT the request of the editor of this journal, I made my way to the metropolis of the Midlands, and set out for Small Heath, the name of which place is so familiar to all footballers. I inquired of the tram-conductor if he could direct me to Somerville Road School, and his reply was so couched that I at once realised that my education had been sadly neglected. Following his directions, I soon arrived at the school. Here, hard at work, I found Mr. Hayward, the subject of this article. We had met before, but this interview deepened the impressions which I had formed of his courtesy on previous occasions.

The building in which I found myself is magnificent for its purpose, and consists of a central hall, which in itself is an education, for it is more of a picture gallery than a schoolroom. I learned that most of the pictures had been carefully selected by the head-master, and afterwards framed by him. These works of art—for so they are—are tastefully arranged. Ranged around the hall are twelve classrooms, and these all lead into corridors which lead to the playgrounds. I cannot do better than quote the words of the special correspondent of *The Daily News*, who thus describes the school: "Some of these Birmingham schools are among the best in the kingdom. I have just been into one which, for brightness, convenience, and completeness, it would be very hard to beat anywhere. This is the Somerville Road School, up in the neighbourhood of Small Heath Park. It is not, of course, so large as some of our great London schools, but it is about as near perfection as one can conceive of anything of the kind. As an illustration of the minute care with which every detail of the school has been studied, I may mention the swinging-doors between the rooms. Doors of the ordinary construction, when allowed to swing freely, are liable to pinch the children's fingers. However carelessly these doors are flung to and fro, they will not pinch. When they swing together their edges won't meet. They stop short, with an interval of an inch or so between them, and then they come together very gently by atmospheric pressure."

The staff consists of the head-master, two chief assistants, one on each side of the school, a certificated teacher in charge of each classroom, and four pupil teachers. In addition to these, there are visiting teachers for science, drawing, drill, and sewing. I was greatly impressed with the quiet and unobtrusive manner of the teachers; in fact, the work of the school seemed to go along so smoothly, that I could not help wishing that some teachers, who seem to think that bustle and worry are necessary to real work, could have been with me. Here, again, was the reflection of Mr. Hayward's personality, and I was not surprised to learn that the Chairman of the Birmingham School Board had once remarked, on entering the school, that he felt he was breathing an atmosphere of education. Each classroom was decorated—I use the word advisedly—with the work of the children; for I understand that Mr. Hayward takes a pride in and exercises personal supervision over the paper-work. I also had an opportunity of hearing lessons in a variety of subjects, and I could not refrain from congratulating him on the selection of his colleagues; for this word better expresses the relationship which exists between the head-master and his assistants.

The drawing lesson in one of the rooms was quite a revelation to me, and I am sorry that a large selection of this work



[Photo by W. Jerome Harrison, F.G.S.

CLASSROOM, STANDARD III. TEACHER: MISS REED.

cannot be photographed and produced in connection with this article. One of the chief features was the free-arm work on large sheets of black and brown paper and on blackboards. The accompanying photograph shows a set of boys at work under the supervision of their teacher, Miss Reed, and the results obtained clearly show her deep interest in the subject. After seeing these youngsters at work, I was better prepared for the striking productions of some of the older scholars, the cleverness of which may be judged from the following picture. The clever original designs and brush-work drawings of these boys were marvellous.

The singing of the upper division (Standards VI. and VII., boys and girls) was *the* feature of the morning's visit. The voice exercises and sight tests were wonderfully well done; indeed, after hearing them, I could easily believe in the successes of the school choir in the competitions which take place yearly in the Birmingham Town Hall. At one of these competitions, Mr. A. R. Gaul, the well-known composer, in the course of his remarks, laid special stress on the tone quality of this choir. Several songs were rendered in a really magnificent style, and I was specially delighted with "The Nightingale" (Weelkes) and "When Winds breathe soft" (Webbe).

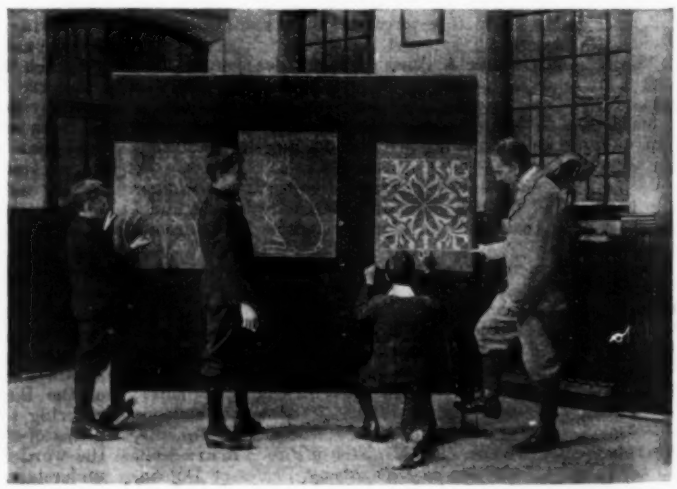
In addition to the successes gained in this subject, I was informed that the trophy for dumb-bell drill, known as the "Kenrick Challenge Shield," had three times been awarded to a squad from this school; this is the more remarkable as only one other school, and that instructed by an old assistant of Somerville Road, has succeeded in winning it twice. The following report from *The Birmingham Daily Gazette*, September 11, 1897, will better convey to my readers the excellence of this performance: "How thoroughly impressed the judges were with the superb work of the Somerville Road boys is proved by the fact that the lads gained, in the opinion of one of them, a maximum, one mark under from another, and the third only deducted two marks from the possible total of 80. The lads actually obtained 237 out of a possible total of 240, from judges who did not consult each other, and were posted in different parts of the hall. The marching was wall-like in its solidity, girl-like in grace, while the general effect lacked nothing in precision. The instructor, Mr. J. Commander, may be justifiably proud of his pupils, as they should be grateful to him." The girls have also carried off twice the trophy for stave-drill under the direction of Miss Evans, the senior assistant mistress. I had also an opportunity of witnessing an assembly in the playground after recreation, and here again I was impressed with the quiet, orderly, and methodical way in which the children were marshalled into school. The whistle was blown, and at once, as if by magic, every child became statuesque. The second whistle was the signal for "Quick march" into line, and in a few seconds, it seemed, the noisy playground was quite deserted.

In addition to the work in progress, Mr. Hayward was good enough to show me a large selection of work done by old scholars. It is considered by the children of this school a distinct honour to be able to leave behind something that is worthy of being retained; and the collection which I saw included poems, face drawings, drawings of flowers, animals, and a fine crayon enlargement from a photograph of Mr. Hayward, executed by an ex-pupil, who has since achieved considerable distinction as designer for a well-known Birmingham firm.

Outside the ordinary routine of school work there is plenty of evidence of energy and resource. The institutions of the school are numerous. Among them may be mentioned "Visiting Days," the object of which is best explained in Mr. Hayward's own words, copied from a circular issued by himself in conjunction with Miss Eld, the mistress of the infants' department, in 1894, to the parents of the children:—

"DEAR SIR AND MADAM,—To give you an opportunity of seeing these schools and noticing the progress of your children, we intend to appoint from time to time what we call VISITING DAYS. On these occasions we invite you to come to school while lessons, etc., are being done, and take a walk round. You will, without interfering with what you see, be able to gather a great deal of knowledge as to what school life is, and we hope your visits will be the means of deepening the interest which we feel sure you take in the welfare of your children."

Mr. Hayward believes most strongly that the school life of a child should be the happiest period of its existence, and he is always seeking for opportunities to put this theory into practice. It is with this object that each year "May Day" is celebrated. The May Queen is chosen from the highest class by the votes of her comrades, while the maids of honour



[Photo by W. Jerome Harrison, F.G.S.

SPECIAL FREE-ARM WORK. TAKEN IN CORNER OF HALL.

and the pages are chosen by the Queen herself. On May Day morning the large hall of the school is transformed into

a corner of Fairyland; for nearly every child brings a floral offering, which is, after the ceremony, forwarded to the hospital. The programme consists of the crowning of the Queen, and songs suitable to the festival are rendered, as well as several May-pole dances by the infants. This ceremony is repeated in the evening for the benefit of the parents.

Another factor in Mr. Hayward's success is the cultivation of a close acquaintance with the parents of his children, and this results in evoking among them a large amount of interest in the work of the school. To stimulate both the interest of parents and scholars, a yearly exhibition of scholars' and ex-scholars' work is held at the end of the school year, when every branch of school work is represented. I had an opportunity of seeing some of the exhibits, and I was particularly struck with the science illustrations, both in the form of drawings and models. I was told that the ironing and cooking competitions were sources of great interest to the mothers of the children, as also was the exhibition of raw silk shown by the children, who had early in the year received silk-worms from Miss Eld. The beauty of the arrangements of leaves and flowers showed that this side of the children's education had received careful fostering. First and second prizes are awarded in each branch of work; and the distribution of these prizes is the occasion, a day or two later, for another gathering of the parents. Last year the prizes were distributed by the Rev. E. F. M. MacCarthy, M.A., Chairman of the Birmingham School Board, while the previous year the children and parents were fortunate enough to secure the attendance of the Lord Bishop of Coventry. This is considered a very important day in the school year, and corresponds to Speech Day in the public schools.

I have already hinted at the high tone of the school, and at the happy relationship—the great secret of the school's success—which exists between teacher and taught; but I should like to give a proof of the existence of this state of things. It is perhaps one of the most novel and unique institutions of the school, and is known among the children as "Mr. Hayward's Christmas Letter." For the last six years each child has received a closed envelope, with instructions not to open it until Christmas morning. The enclosure takes the form of an earnest and thoughtful little letter. I was told that only in one instance, and that a thoughtless one, has the instruction been violated. The following is a copy of the Christmas letter for 1897. It is typical of the rest, and will be read with interest by those teachers who want to know of a good plan for inculcating a good tone among their scholars.

[*Photo by W. Jerome Harrison, F.G.S.*

DOMESTIC ECONOMY CLASS.

"'ST. LEVEN,' TENNYSON ROAD, SMALL HEATH.

"MY DEAR SCHOLAR,—Christmas Day has come once more, and you have my fourth little letter to read. I hope it will find you bright, and glad, and full of joy. Christmas Day is a day of happiness. Church bells peal forth their merry notes. Sweet songs are heard at every turn. They tell of peace—'PEACE ON EARTH.' How happy you ought to feel! Your little heart should beat with love—love for all at home, for friends that are away, love for all you know. But to feel is not enough. Your love should prompt you to say—to do. Do, then, something—something of use, something that will cause a ray of light to shine where darkness else would be. Let it be done cheerfully, without a thought of self, serving one another, helping each other. Add to your own joy by giving pleasure to others, remembering that the days are lost in which we do no good; worse than lost in which we do evil.

"May the New Year smile on you, and bring you all things good. May health and happiness brighten your days. May strength of limb and beauty of heart make your life of worth. May you be pure and true as a lovely flower, giving sweetness, delight, and joy to all that are around.—With best wishes, I am, your affectionate Master and Friend,

"CHAS. F. HAYWARD.

"*Christmas Day, 1897.*"

I understand, and can readily believe, that the good done by these letters is incalculable, and that visitors to the school and friends of Mr. Hayward have asked for a copy year by year. Answers are received from old scholars and friends; and I was privileged to see replies from the Dean of Christ Church, Oxford, several bishops, Sir John Lubbock, and the late head-master of Harrow, all of whom spoke in the highest terms of praise of this production. These are only a few of the institutions of the school, but there are others equally useful, which raise the school from the ordinary level of an elementary school. I hope I am not betraying the confidence reposed in me, but I am awaiting the first production of the school magazine. There will, I am sure, be no difficulty in finding matter for such a publication, if it be only a record of work done; and I am quite sure that old pupils and friends will eagerly look forward to its issue. It is quite a usual thing for the children to give assistance at concerts, fêtes, and other gatherings of a like character, and descriptions of such help will no doubt appear in the school organ.

The schemes of work, arranged by Mr. Hayward, show evidence of much thought and care. Composition is taken in place of dictation, though, of course, spelling is not neglected. This is the scheme for Standard I.:—

Scheme for combining Word Building, Dictation, and Composition.

STANDARD I.

First Term.

1. Word-making by addition and subtraction of letters to word-roots, taking care by good selection to avoid awkward examples.
   For example,—*art*, add *p* to make part, add again to make de-part, -ed, -ing, etc.
   Value of vowel to be known. Short ă + consonant, long ā + vowel.
   For example,—tŏn, tōne; păst, pāste, etc.
2. Combination of any syllables.
   For example,—man-y-sto-pan-tin-o-fetch, etc, pronounced slowly at first, then rapidly, as though one word.
   (*Note.*—This to help reading in future years, when less time can be spared for this subject.)
3. *Dictation.*
   Exercises of easy words and word-members.
   For example,—an, pan, ant, pant, pant-ed, pant-ing, etc.; am, amp, tamp, tamp-er, stamp, stamp-er.
   Dictation of easy words in complete sentence form.
   For example,—Many boys and girls come to school.

SOMERVILLE ROAD SCHOOL, BIRMINGHAM—TIME

	Stan.	MORNING. 9 to 9.15.	9.15 to 9.35.	9.40 to 10.30.	10.30 to 10.45	10.45 to 11.30.	11.30 to 12.	AFTER 2 to 2.15.	2.20 to 2.50.
MONDAY.	VII.	Bible Reading.	Moral Instruction.	Arithmetic.		Grammar.	Singing.	Physical Exercises.	Reading.
	VI.	,,	,,	,,		,,	,,	,,	,,
	V.	,,	,,	,,		,,	,,	,,	,,
	IV.	,,	,,	,,		Word Building.	,,	,,	,,
	III.	,,	,,	,,		,,	,,	,,	,,
	II.	,,	,,	,,		,,	,,	,,	,,
	I.	,,	,,	,,		,,	,,	,,	,,
TUESDAY.	VII.	Religious Service (9 to 9.30.)		Copy Books.		Arithmetic.	Recitation.	Bible Reading.	Woodwork Drawing Science (2.20 to 3.20).
	VI.			,,		,,	,,	,,	,,
	V.			,,		Drill.	,,	,,	Drawing (2.20 to 3.20).
	IV.			,,		Object Lesson.	,,	,,	,,
	III.			,,		,,	,,	,,	,,
	II.			,,		,,	,,	,,	,,
	I.			,,		,,	,,	,,	,,
WEDNESDAY.	VII.	Bible Reading.	Mental Arithmetic.	Brush Drawing.	RECREATION.	Grammar.	Singing.	Physical Exercises.	Composition.
	VI.	,,	,,	,,		,,	,,	,,	,,
	V.	,,	,,	,,		,,	,,	,,	Reading.
	IV.	,,	,,	,,		Arithmetic.	Object Lesson.	,,	,,
	III.	,,	,,	,,		Drill.	,,	,,	,,
	II.	,,	,,	,,		,,	,,	,,	,,
	I.	,,	,,	,,		,,	,,	,,	,,
THURSDAY.	VII.	Bible Reading.	Mental Arithmetic.	Arithmetic.		Composition.	Recitation.	Mental Arithmetic.	Science (2.20 to 3.20).
	VI.	,,	,,	,,		Drill.	,,	,,	Reading.
	V.	,,	,,	,,		Science.	,,	Woodwork	at Centre.
	IV.	,,	,,	Hand and Eye Training.		Dictation.	,,	Mental Arithmetic.	Reading.
	III.	,,	,,	,,		,,	,,	,,	,,
	II.	,,	,,	,,		,,	,,	,,	,,
	I.	,,	,,	,,		,,	,,	,,	,,
FRIDAY.	VII.	Religious Service (9 to 9.30.)		Composition.		Drill.	Singing.	Bible Reading.	Drawing (2.20 to 3.20).
	VI.			,,		Science.	,,	,,	,,
	V.			Arithmetic.		Composition.	,,	,,	,,
	IV.			,,		,,	,,	,,	,,
	III.			,,		,,	,,	,,	,,
	II.			,,		,,	,,	,,	,,
	I.			,,		,,	,,	,,	,,

Examined by Board's Inspector.
Approved on behalf of the Board by Clerk of the Board.
Approved on behalf of the Education Department, as fulfilling the requirements of Section 11.

4. *Composition.*

Oral composition to consist of simple sentences, the meaning of which will be quite within the reach of the boys' and girls' understanding. Object lessons, conversations, and actions seen or done by the children to form bases of subjects.

For example,—Leaves grow on trees. (Object lesson.)
What shall we do next? (Conversation.)
The teacher has broken the chalk. (Action.)

Second Term.

1. Continuation of (1) in first term. To pass on to more advanced syllables.

For example,—ail, pail, sail, sail-or, sail-ing;
ale, pale, sale;
-igh, sigh, -ed, high, -er, thigh, etc.

The use of the words to be shown in sentences.

For example,—The pail is full of water. The little girl had a pale face, etc.

2. To continue syllables; now, however, with some definite word in view.

For example,—com-pre-hen-sive, par-tic-u-lar, etc.

3. *Dictation.*

Sentence to be taken from reading book, prepared by dismemberment if necessary, learned, and dictated one word at a time.

Typical sentence: The ring went on her fin-ger quite eas-i-ly.

4. *Composition.*

Exercises to be oral, written afterwards on blackboard, and afterwards, independently of teacher's help, on paper. During this term the treatment of each sentence to be as follows:—(1.) Sentence given by child. (2.) Teacher to write sentence on blackboard. (3.) Sentence read by children. (4.) At close of lesson, sentence to be copied.

Preparation for head-master's test—namely, one or two such sentences.

Third Term.

1. To be able to dismember any word from reading book. To make any word by addition of syllables. Use of various combinations of vowels, but not very difficult.

Types of words,—each, reach; ready, al-ready; feather.

2. *Dictation.*

Short sentences, dictated one word at a time.

(*Note.*—For experimental purposes, let the children learn an easy sentence and write it from memory—for example, Birds build nests, and live in them.)

Introduce—there is, there are, there were, etc.

3. *Composition.*

Easy sentences, as in last term.

The object-lesson schemes are also comprehensive. They show a thoughtful solicitude for the teaching of science in the upper standards. The boys are led through the paths

BOYS AND GIRLS, UPPER DEPARTMENT.

TABLE.

NOON.				SUMMARY.
2.50 to 3.30.	3.30 to 3.40.	3.40 to 4.15.	4.15 to 4.30.	Number of Minutes devoted to the various subjects.
Geography.		Science (to 4.25). Woodwork	Mental (4.25 to 4.30). at Centre.	
,,		Composition.	Spelling.	
,,		Transcription.	,,	
,,		,,	,,	
,,		,,	,,	
,,		,,	,,	
and Solid Geometry.		French.	French.	
Mental (3.20 to 3.30).		Plane Geometry.	Spelling.	
,,		,,	,,	
,,		Reading.	Physical Exercises.	
,,		,,	,,	
,,		,,	,,	
,,		,,	,,	
Geography.		Woodwork	at Centre.	
,,		Reading.	Spelling.	
,,		Composition.	,,	
,,		,,	,,	
,,		,,	,,	
,,		,,	,,	
,,		,,	,,	
Geography (3.20 to 3.30).		Shorthand.	Shorthand.	
Geography.		Model Drawing.	Spelling.	
Woodwork at Centre.		,,	,,	
Drill.		Transcription.	,,	
,,		,,	,,	
Geography.		,,	,,	
,,		,,	,,	
Mental (3.20 to 3.30).		Reading.	Physical Exercises.	
,,		,,	,,	
,,		,,	,,	
,,		,,	,,	
,,		,,	,,	
,,		,,	,,	

RECREATION.

	St. I.	St. II.	St. III.	St. IV.	St. V.	St. VI.	St. VII.
Bible Reading	75	75	75	75	75	75	75
Moral Lessons	20	20	20	20	20	20	20
Reading	160	160	160	160	95	130	65
Spelling	45	45	45	45	60	45	..
Transcription and Dictation	115	115	115	115	..	..	..
Composition	80	80	80	80	115	80	115
Copy Books	50	50	50	50	50	50	50
Written Arithmetic	100	100	145	100	150	145	145
Mental Arithmetic and Tables	75	75	75	75	75	75	70
Recitation	60	60	60	60	60	60	60
Grammar and Word Building	45	45	45	90	90	90	90
Geography	120	120	80	80	80	120	90
Shorthand	..	..	..	..	..	..	50
Drawing	170	170	170	170	180	180	180
Needlework	140	140	140	140	140	140	140 (girls only).
Singing	60	60	60	90	90	90	90
Object Lessons	75	75	75	45	..	..	..
Hand and Eye Training	50	50	50	50	..	..	..
Manual Instruction	..	..	..	..	80	80	80
Specific Subject—i. Chemistry	..	..	..	..	105	105	105 } alternate
Do. ii. Mechanics	..	..	..	..	105	105	105 } weeks.
Cookery	..	..	..	..	..	..	..
Drill and Physical Exercise	105	105	100	100	90	90	90
Recreation	125	125	125	125	125	125	125
Registration	60	60	60	60	60	60	60
French	..	..	..	..	..	..	50
Total Number of Minutes	1500	1500	1500	1500	1620	1620	1620

Religious Instruction—Tuesday and Friday, 9 to 9.30—by Vicar of Parish.

NOTES.

1. A Criticism Lesson, at which all the teachers are present, is given every first Wednesday in the month, at 11.30. All classes but one are dismissed at 11.30.
2. The Registers are marked at 9.35 a.m. and 2.15 p.m., and are finally closed at 9.40 a.m. and 2.20 p.m.
3. Girls take Sewing on Tuesday and Friday afternoons from 2.20 to 3.30 in lieu of the lessons set out above.
4. Where boys attend Woodwork, girls may take Special Work.
5. Girls attend at Cookery Centre as follows:—V. Tuesday, VI. Wednesday, and VII. Thursday.

of the Education Act, by H.M. Inspector of Schools.

of elementary science to the subjects of chemistry and mechanics, while the girls receive elementary lessons in botany and physiology in the lower standards, in preparation for their domestic economy lessons in the upper part of the school. The photograph shows a lesson being given in the last-mentioned subject by Mr. W. Jerome Harrison, F.G.S., the chief science demonstrator to the Birmingham School Board. In Standard VII., in addition to the ordinary work, there are classes for commercial subjects, which include shorthand, commercial correspondence, and French.

From the foregoing remarks it will easily be believed that Mr. Hayward is much beloved of his scholars and staff, and is exceedingly popular in the district in which he lives. This is the result of his thoughtful consideration for and fairness in all things belonging to school matters. Every teacher knows how keenly children resent injustice; and it is this knowledge that has made Mr. Hayward resolute to be, above all things, just, and to see that all his children are treated with justice. He is careful and methodical, and, I believe, in every detail acts up to the school motto, "Thorough."

His experience is wide. He was apprenticed at the National School, Wellington, Salop, under the late Mr. S. Kay Booth, who became one of H.M. Inspectors; and during his apprenticeship he came closely under the teaching and influence of Dr. J. Edward Cranage, the head-master of the Old Hall School, Wellington, to whose teaching he attributes his love of the classics, a subject in which he is well read. It was intended that he should become an assistant master in this school; but while the doctor was away on a tour in Palestine, he applied for and obtained an assistantship in the Wellingborough Grammar School. He has never regretted the experience undergone in this well-known school under the mastership of Mr. W. Winterton; indeed, he often looks back with pleasure at the opening it gave him for teaching in the higher subjects. Saltley is his *Alma Mater*. He entered this college in 1878, well up on the scholarship list, and has kept up his connection with that institution, as a worker for its benevolent fund, ever since. Birmingham secured his services, and his parchment was gained at the Hope Street Schools. "Mr. Hayward teaches," was his first entry; and I believe that the estimate, formed and recorded on that document, expresses all that a teacher would like to have said. He became afterwards an assistant master in the well-known Huddersfield school at Spring Grove. Here it was his good fortune to work under that giant of schoolmasters Mr. George Sharples, from whom he learned, as he confesses, much of his power of organisation and skill in school management. It was at this school that he had as colleagues Dr. Macnamara and Mr. Richard Waddington—for a short time only, it is true, but long enough to learn from them many of the good qualities that have brought them to the front as teachers of the higheat order. They have remained his firm friends to this day. Mr. Hayward's first charge was the Stourbridge Road Board Schools, Bromsgrove,

and it was here that he first took up practical N.U.T. work. I believe he was one of the trio that established the famous symposium at the Cheltenham Conference. He passed through the various offices of the association, and so indefatigably did he work that, when he came to Birmingham, he was almost immediately appointed secretary to that association, which at that time was not nearly so strong as at the present time. He was Conference secretary in 1888, and still looks back with pride at the magnificent work the Conference Committee and the association did in widening the influence of Conference as a powerful institution. The formal reception at Conference by the Town Council, the presentation of the Birmingham Trophy in connection with the funds, are two of the events that have kept Birmingham Conference in the memory of teachers to this day, and in instituting these Mr. Hayward took a large part. I think it a pity he has not kept up with the local association work; but his lines have been cast in other places. He has no desire to pose as a platform speaker, or as a leader of teachers, but rests content with his professional duties, and devotes almost all his time to these. As a master, speaking at his own meetings and to the parents of his scholars, I have heard that he always says a good thing, and always says it well; while in his addresses to his scholars he has a wonderful power of riveting their attention and driving home the facts he wishes to impress. I am told by one of his teachers that his happy way of coming down to the children's standard of understanding is remarkable.

He enjoys the entire confidence of the School Board under which he works; and a peep into the letters he has received from many of the leading educationists who have visited the school, and who have written to him acknowledging his courtesy and expressing their strongest approval of his methods, would convince the most sceptical that the motto of his school has been rightly chosen.

Asked as to his opinion of the working of the new Code, Mr. Hayward readily replied that he thought the "block grant" system of payment would result in a less crowded time-table in the majority of cases than heretofore, and a greater elasticity in the choice of subjects. These would be chosen with a special view to the children's wants in after life, and would be taught in such an attractive way as would lead to a greater attendance at the evening continuation schools. It would also open the way to a better understanding between the teacher and the inspector—a most desirable state of things; for where the latter is a true educationist, he and the teachers would be in more frequent conference. This would lead to a truer form of education, and a stimulus would be given to special work. He was sorry that no addition to the grant to infants' schools was contemplated, and viewed with dissatisfaction the fact that the grant to a good school was so small as compared with that to only a moderate school. This, he thought, would lead to poor staffing. Mr. Hayward believes most sincerely in the principle of a certificated teacher for forty-five children. It is the children's right to have full and complete supervision in their work and school life, and this cannot be given to them until smaller classes are arranged for each teacher. As far as the Birmingham schools are concerned, and his own in particular, Mr. Hayward believed the new Code would not make much difference in the curriculum. The subjects already taught—and it will be seen from the appended time-table that they are not a few—had in a great measure set the amount as to what was necessary. They took up many subjects, and he had not found that any increase of them, from time to time, had materially affected the quality of the work. It had, to some extent, resulted in less accuracy; but, on the whole, the widening of the children's ideas more than compensated for this. He hoped that in his own school he would be able to commence the preparation for the special work quite low down in the school. He would commence, for example, the teaching of French in the lowest class of all, by teaching the children the French names of the things around them, with just a few phrases in which they could make use of them. The taking away of the special registers, too, he hoped would be conducive to work being done in the whole of the school—in an elementary way, of course—that was formerly left to the higher standards.

THE BELGIAN TEACHERS' CONGRESS.

BY A SPECIAL CORRESPONDENT.

The Congress at Ostend last year paid eloquent homage to the good work done at Saint Gilles, Brussels; and it was suggested, amid much enthusiasm, to hold there the meeting for 1900. The leader of this movement said, "Let us go next year to Saint Gilles; we shall honour the authorities of this commune, which makes every sacrifice for the purpose of education. I wish to add that we shall then have an opportunity to see the most beautiful school in Belgium." The Executive afterwards consented, and chose Saint Gilles unanimously as the place for the Conference which has just been held. The decision was sent to the burgomaster, who brought it before the Town Council, stating that it was a great honour to their commune, and that they thanked the Federation for this mark of their sympathy. It was further agreed to vote a subsidy of £120 to the Local Committee organising the Congress. Of this committee, Mr. Van Meenen, the burgomaster, was honorary president, and Alderman Morichar honorary vice-president. These names are specially mentioned in recognition of the splendid services both gentlemen have rendered, not alone to the Congress, where their attendance was frequent, but also to the cause of education in Belgium. The effective local work was carried out by Mr. Dries, president, Mr. Ketelaar, secretary, and others, to whom every credit must be given for the magnificent result of their labours. We give them our heartiest congratulations.

So much by way of introduction; now for the Conference itself, which was held on September 2, 3, and 4. The evening of September 1 saw many teachers from Brussels and Saint Gilles, which is a commune adjoining Brussels, at a social gathering, where Mr. J. F. Blacker and Mr. H. Coward were heartily welcomed as the representatives of the National Union of Teachers of England. In fact, a deputation waited for them at the hotel, and conducted them to the Reunion, where "God save the Queen" was sung with much enthusiasm.

Next day, in the square near the southern station, the members of the Congress met and proceeded to the gymnasium of the school, in the Rue de Bordeaux, Saint Gilles, where the proceedings were to be carried out. Here the representatives were received by the Local Committee. The address was delivered by the president of the Local Committee, Mr. Dries. It was an able and exceedingly interesting account of the progress of educational institutions, locally, during the last forty years. Eloquent testimony was given to the valuable work of Mr. Van Meenen and Mr. Morichar, who had been successively "Échevin" of public instruction—a position somewhat analogous to the chairman of the Education Committee. These officers of the commune have introduced a number of reforms, and instituted many new developments. Amongst them may be noted: equal salaries for men and women who, Mr. Dries held, carry out the same studies and render the same services. The scheme of Mr. Morichar provides that in twenty years the initial salary shall be doubled. The maximum salary reaches 4,200 francs, and the increase is so arranged that the pension may be calculated upon the basis of the five most favourable years, and after thirty-four years of service may reach 2,800 francs, or £112.

There was a very large attendance at the opening of the Congress, and, indeed, throughout. The president, Mr. Van den Dungen, gave no set address. The English delegates were warmly received. Mr. Blacker delivered a speech in French. After presenting the good wishes of the N.U.T. for the success and continual prosperity of the Belgian Federation, and thanking the members present for their warm reception, he spoke of the great work in which teachers were engaged, and of the universal progress which had been made. He believed that there was no object more grand and noble than that which made for the development of the mind, and which gave also the rules which should govern life. Progress was the aim of all, and here, as elsewhere, "union was strength." He had all confidence in magnifying the office of teacher, because they all loved to

follow their vocation. Mr. Coward's speech in English was translated by the esteemed president, Mr. Van den Dungen, with that ability which is so well known to those who have had the pleasure of meeting him at the conferences of the N.U.T.

The representatives of France, Messrs. Wartel and Landa, with those of Holland, the president, our old friend Mr. G. Meyer, and Mr. G. Knappenberg, also conveyed their felicitations to the members present.

The meeting ended at four o'clock, and an adjournment was made to take part in the function of laying the foundation stone of a new Hotel de Ville, at which places were reserved for the members of Conference. At nine in the evening the official reception by the burgomaster took place at the school. It was a most interesting and admirable gathering. The school, a fine building, well furnished throughout, was decorated; and the playground was illuminated with fairy lamps, which gave a very charming appearance to the flower-beds. Imagine flowers in plots in English school playgrounds! After speeches by the burgomaster, Mr. Van Meenen, and Mr. Morichar, whose eloquence evoked suitable responses from the local president, Mr. Dries, and the president of the Federation, Mr. Van den Dungen, the band discoursed sweet music, an impromptu dance was started, and all went "merry as a marriage bell." A goodly number of the fair women knew English, but only "a leetle." It is fair to say they seized every opportunity for trying to become efficient. The Englishmen enjoyed it. It was "All right." "Tank you," as the Belgian ladies said.

Next day at nine o'clock the sections met separately—the French section in the gymnasium and the Flemish in the sewing-room. They considered the replies which had been sent to the questions forming the "order of the day of the Congress." This "agenda" consisted of four questions, as follows:—

1. (*a*) Show the influence of communal government—
   (1) On the primary and general instruction.
   (2) On the position of the teacher.
   (*b*) Determine the basis of a law relating to the resumption of the instruction by the State.
2. Is it not time to reorganise primary instruction for girls? If so, what modifications should take place in the organisation of these schools?
3. Reading in the primary school—its character and importance. Means to make it loved, and to develop a taste for it. Literature appropriate to the level of the child's mind.
4. In what manner can the primary school and the teacher favour unity in the pronunciation of the language of the Netherlands? (This question shall be treated only by the Flemish section.)

After the sections had finished their deliberations on replies received beforehand from the provinces—divisions—their conclusions were separately considered and voted upon at a general meeting on Tuesday morning. Monday afternoon was devoted to visiting the sights, which were numerous and varied, as the list will show: Solvay Institute and the Institute of Leopold Park, Royal Observatory, Hotel de Ville of Brussels, school museum, the old Hal Gate, gasworks, brewery. The English representatives voted for the Hotel de Ville, in which they found objects of the highest interest: paintings, sculpture, and a crowd of other things, some of them recalling the night before Waterloo, when

> "There was a sound of revelry by night,
> And Belgium's capital had gathered there
> Her beauty and her chivalry."

And afterwards they went to the Grande Place, where every house is beautiful, and the whole a dream of architectural loveliness.

But to return once more to the programme. At eight o'clock there was a performance at the Théâtre Molière. The best places were reserved—other committees please copy—for the members of the Congress living in the country, on the condition that the places should be taken on Monday morning between eight and nine, at the school. The other remaining places would be placed at the disposition of those living in or near Brussels, after the morning sitting. But, alas for the Brussels teachers, there were none left!

The last session on Tuesday morning at nine was occupied in animated discussion on the conclusions arrived at by the two sections before referred to. This, however, was interrupted to give a welcome to Senator H. La Fontaine, who delivered an eloquent address on "Peace." This was received with unbounded enthusiasm. Then matters became lively; but the president, who operated on a bell of rather serious dimensions, evidently knew his audience. He never lost for a moment his calmness; first one, then another, "had the word," or was called on to speak. What was the fight about?

This was the resolution: "The general direction of primary education (Froebel, primary, adult, housewifery, and professional schools) belongs to the State, in accordance with the organisation which controls teachers officially recognised by the law." The urban teachers, who seem well satisfied with the communal system, fought against its alteration; whilst the rurals, with a determination and force in itself admirable, struggled for the abolition of the "small School Board," for, as they said, "the direction of primary instruction is vested in a great many communes in persons who are not competent to assure the good organisation of this important service." The result was compromise. The foregoing resolution was passed, with this addition: "The large communes may preserve their local government, provided that they augment the minimum programme and the salary of the teachers."

Many other conclusions were adopted, and the very practical agenda for a conference was finished!

The last function was the dinner. The following account is from *La Réforme*:—

"The Congress of Teachers has been closed by the traditional banquet, which took place at the Hotel de l'Esperance, one of the most celebrated restaurants in the country—that is to say, it leaves nothing to desire; carefully-prepared *menu*, first-class cooking, exquisite wines, and that which spoils nothing—prompt and attentive service. The banquet, which was full of cordiality and animation, will leave very pleasant memories with all who were present.....Let us say that Mr. Van Meenen, burgomaster, proposed the Nation, the King, and the Federation and its president, who had been twenty-five years head-master at Saint Gilles. Mr. Van den Dungen proposed the burgomaster, Alderman Morichar, and the Communal Council. Mr. Morichar, in a speech of great power, rendered testimony to his co-worker, Mr. De Vogel. Mr. Dries, the local president, proposed the foreign deputations, to which Mr. Blacker (England) responded excellently, first in French, then in English. M. Landa (France) proposed 'The International Union of Teachers of all Countries.' Following him came the Dutch delegates, and Mr. Meyer and Mr. Ketelaar responded in their turn with charming speeches. Then Mr. Van den Dungen, after an allusion to the war in South Africa, gave the toast "Peace." Mr. Rossignol in felicitous terms recognised the work of the Organisation Committee and the Press, to which Mr. Lekeu replied by a speech full of force, arousing the warmest enthusiasm." And so on. But it should be mentioned that Miss Charlier replied very gracefully on behalf of the "Ladies."

The Following Contributions will appear

NEXT MONTH:—

THE INSTRUCTION OF GEOGRAPHY IN ELEMENTARY SCHOOLS. By T. G. Rooper, H.M.I.

SPECIMEN SCHEMES OF OBJECT LESSONS FOR THE NEW CODE.

PARIS EXHIBITION CONGRESSES—

III. Elementary Teachers. By our Special Correspondent.

THE PRACTICAL INFANT SCHOOL TEACHER SECTION—

What we understand by Kindergarten, and How we try to carry out its Principles. By Headmistress of a Large Infant School.

NATURE LESSONS FOR INFANTS. (Illustrated.)

MODERN LANGUAGE HOLIDAY COURSES.

I. GENEVA.

In our issues for June and July we printed particulars relating to the numerous holiday courses to be held in various parts of the Continent during the months of July and August. As in previous years, we have again arranged to publish in

THE UNIVERSITY BUILDING, GENEVA.

these columns a few notes by practical teachers who have spent some time at these courses.

The *Cours de Vacances de français moderne* are held in France and Switzerland. Knowing from past reports that British teachers were in fairly good attendance at Paris, and at the Teachers' Guild Courses at Elbeuf, Lisieux, and Tours, we specially visited Geneva and Lausanne, in order to see how far our teachers had availed themselves of the opportunities offered at each of the universities. At Geneva we found some two hundred and fifty men and women students, who came from every part of Europe, and of this number *two* only were from Great Britain! At Lausanne, out of a similar gathering of a hundred, there were but *three* from England!

The small attendance of teachers and students from this country is doubtless due to the fact that the work carried on at these classes is as yet practically unknown. The following notes may therefore be of interest to many of our readers, who may be inclined another year to test the advantages to be gained from attendance at courses conducted by so many able and efficient tutors.

At Geneva the classes are held in the buildings of the university and at the Palais Eynard. The course lasts for six weeks—that is, from the middle of July until the end of August. Twelve hours each week are allotted to lessons, which are given every morning except Saturday. The whole are under the direction of M. Bernard Bouvier, Professor of Literature and Social Science at Geneva University, who is assisted by a number of other distinguished teachers. The following is the programme of studies:—

Littérature contemporaine (12 leçons).—Professeur, M. Bernard Bouvier. *Études sur quelques poètes français du XIX^me^ siècle.*

Littérature classique (6 leçons).—Professeur, M. Bernard Bouvier. *Études sur la comédie de Molière.*

Lecture analytique (6 leçons).—Professeur, M. Bernard Bouvier. Analyse littéraire et commentaire critique des *Morceaux choisis d'écrivains français au XIX^me^ siècle*, publiés à l'usage des Cours de Vacances de français moderne à l'Université de Genève.

Exercices de rhétorique et de discussion (6 leçons).—Professeur, M. Bernard Bouvier. Les sujets d'analyses, d'exposés et de discussions littéraires proposés aux participants seront empruntés aux *Morceaux choisis de prose et de poésie française*, publiés à l'usage des Cours de Vacances de français moderne à l'Université de Genève.

Institutions et mœurs en pays de langue française (6 leçons).—Professeur, M. Henri Mercier. *La France sous le second Empire. I. Les constitutions, le droit électoral. II. Les libertés publiques; les clubs; la presse. III. L'instruction publique. IV. Les théâtres. V. La vie de société; plaisirs; fêtes; expositions. VI. En province; travaux publics; transformation économique.*

Psychologie et pédagogie appliquées (6 leçons).—Professeur, M. Henri Mercier. Exposés et discussion de diverses questions de psychologie enfantine et scolaire.

Exercices de stylistique (12 leçons).—(*a*) Pour les participants de **langue allemande**—Professeur, M. Ch. Bally. Théorie du style français, accompagnant la traduction des *Morceaux choisis d'écrivains allemands modernes*, publiés à l'usage des Cours de Vacances de français moderne à l'Université de Genève. (*b*) Pour les participants de **langue anglaise**—Professeur, M. R. Harvey. Théorie du style français, accompagnant la traduction des *Morceaux choisis d'écrivains anglais modernes*, publiés à l'usage des Cours de Vacances de français moderne à l'Université de Genève.

Syntaxe française, gallicismes, questions d'usage (6 leçons).—Professeur, M. L. Zbinden. Etude de la syntaxe actuelle, d'après un choix de *Nouvelles* de G. de Maupassant.

Diction et prononciation (12 leçons).—Professeur, M. G. Thudichum. Exercices d'élocution et de diction, d'après le recueil de *Morceaux choisis de prose française* à l'usage des Cours de Vacances de français moderne à l'Université de Genève. Exercices raisonnés de prononciation d'après le manuel de M. G. Thudichum: *L'articulation des sons du français.* 1°. *Le mécanisme;* 2°. *École du mécanisme.* Les participants à la conférence seront divisés par groupes de nationalités pour rendre plus aisée la correction des fautes propres à la prononciation de chacune d'elles.

Groups for conversation and for correction of work, under the direction of competent persons, are formed during the first week of the courses, and subsequently meet twice each week. A singing course, superintended by a professor of music, meets twice each week for the purpose of studying selected pieces from a collection of French-Swiss songs. The inclusive fee for all courses is £1, 17s. 6d.

M. Bouvier, as *directeur*, is the life and soul of the work at these classes. In perfect sympathy with all, he is positively revered by this large gathering of international students. His lectures on French literature are intellectual treats. His brilliant sketch of the genius of Alphonse Daudet, to which we listened on the morning of our arrival, was greatly appreciated by all present.

In the classes under the heading of *Exposés et discussions*, M. Bouvier's kindness and courtesy in dealing with the faults peculiar to a student's nationality is deserving of much praise. One student after another mounts the platform, and there delivers a short composition based on a selected piece from the handbook of literary extracts provided. After the reading of each paper, criticism is invited from the students. The remarks relate to vocabulary and phrases employed, construction, style, and pronunciation; and M. Bouvier, in replying to questions and in clearing up difficulties, manages to control the assembly with much tact, besides affording to each and all a good deal of conversational practice.

As will be seen from the foregoing programme, there are

GENEVA UNIVERSITY FROM THE AVENUE DES BASTIONS.

classes entitled *Stylistique Allemand et Anglais.* In these gatherings each student is furnished with a book containing carefully-chosen extracts from modern German or English writers. Sentence by sentence, these are translated into French *vivâ voce.* As a specimen of the pieces selected, we

give the following extract from Ruskin, which we heard translated into French by German and American students:—

St. Mark's, Venice.

§ x. And now I wish that the reader, before I bring him into St. Mark's Place, would imagine himself for a little time in a quiet English cathedral town, and walk with me to the west front of its cathedral. Let us go together up to the more retired street, at the end of which we can see the pinnacles of one of the towers, and then through the low grey gateway, with its battlemented top and small latticed window in the centre, into the inner private-looking road or close, where nothing goes in but the carts of the tradesmen who supply the bishop and the chapter, and where there are little shaven grass plots, fenced in by neat rails, before old-fashioned groups of somewhat diminutive and excessively trim houses, with little oriel and bay windows jutting out here and there, and deep wooden cornices, and eaves painted cream colour and white, and small porches to their doors in the shape of cockle-shells, or little, crooked, thick, indescribable wooden gables warped a little on one side; and so forward till we come to larger houses, also old-fashioned, but of red brick, and with gardens behind them, and fruit walls, which show here and there, among the nectarines, the vestiges of an old cloister arch or shaft, and looking in front on the cathedral square itself, laid out in rigid division of smooth grass and gravel walk, yet not uncheerful, especially on the sunny side where the canons' children are walking with their nursery-maids. And so taking care not to tread on the grass, we will go along the straight walk to the west front, and there stand for a time, looking up at its deep-pointed porches and the dark places between their pillars where there were statues once, and where the fragments, here and there, of a stately figure are still left, which has in it the likeness of a king, perhaps indeed a king on earth, perhaps a saintly king long ago in heaven; and so higher and higher up to the great mouldering wall of rugged sculptures and confused arcades, shattered, and grey, and grisly with heads of dragons and mocking fiends, worn by the rain and hurtling winds into yet unseemlier shape, and coloured on their stony scales by the deep russet-orange lichen, melancholy gold; and so, higher still, to the bleak towers, so far above that the eye loses itself among the bosses of their traceries, though they are rude and strong, and only sees like a drift of eddying black points, now closing, now scattering, and now settling suddenly into invisible places among the bosses and flowers, the crowd of restless birds that fill the whole square with that strange clangour of theirs, so harsh and yet so soothing, like the cries of birds on a solitary coast between the cliffs and sea.

Another important course is that relating to *Pronunciation*. These classes are conducted by M. Thudichum of the International College La Châtelaine, recently described in our columns. M. Thudichum is a practical teacher of much energy, and the fortunate possessor of a rich and clear voice.

STUDENTS' PROMENADE, GENEVA.

By means of a series of charts, students are thoroughly well drilled, and taken step by step through a long course of phonetic exercises. As in all other classes of the Holiday Course, much individual attention is given, and students derive incalculable benefit from the systematic drill in *vowel* and *consonant* sounds and their many combinations.

II. LAUSANNE.

At Lausanne the courses are very similar to those at Geneva. They begin in the middle of July and terminate with August. The inclusive fee is £1, 5s. The classes are held at the Ecole de Chimie, quite close to the Cathedral, as shown in our illustration. Sixteen lessons are given each

FLOWER MARKET, GENEVA.

week, in accordance with the items on the following programme:—

L'enseignement et l'État en France (1 heure).—Prof. ord., M. Vallette.

Histoire de la langue française (2 heures).—Prof. ord., M. Bonnard.

Étude comparative des langues française et allemande (1 heure).—Prof. ord., M. Maurer.

Traductions d'allemand en français (1 heure).—Prof. ord., M. Maurer.

Les nouvelles méthodes appliquées à l'étude des langues vivantes (1 heure).—Prof. ord., M. Maurer.

Questions de politique contemporaine (2 heures).—Prof. ord., M. Rossier. Études et discussions.

Le corps et l'âme dans le roman français contemporain (2 heures).—Prof. extr., M. Millioud.

Phonétique du français moderne (2 heures).—Privat-docent, M. Taverney. Étude théorique et pratique.

Diction et prononciation (2 heures).—Lecteur, M. André. Théorie et exercices.

Études sur le théâtre français contemporain (2 heures).—Lecteur, M. André. Exposés et discussions.

We listened one morning to an admirable lecture by M. André on "Cyrano de Bergerac." At the termination of the lecture discussion followed, as noted at the Geneva classes. One German student proceeded to lecture the lecturer himself by ventilating somewhat aggressively his own opinion as to the defects of the work being studied. With commendable tact M. André turned to good account the speaker's remarks, much to the amusement of the other students.

M. André specialises in diction and pronunciation for the benefit of students and teachers attending the Lausanne courses, and his remarks on good French pronunciation are of the utmost value. His advice to foreigners was this: "Remember that great varieties of pronunciation exist even among cultured people of French-speaking countries, and that too much importance must not be attached to small details. The aim of the foreigner should be to avoid gross faults, exaggeration, and affectation, and to acquire a pleasing, normal style of pronunciation." M. André had visited Paris for the express purpose of studying the pronunciation there, and the conclusion he had arrived at was, that in good society and at high-class theatres good models could be heard, but that elsewhere one would hear and perhaps imitate gross faults.

M. André, who is the editor of a little publication entitled *Causeries Françaises*, recently noticed in our review columns (Payot, Bookseller, Lausanne), has also written an exceedingly interesting and valuable treatise of some eighty pages on "French Pronunciation." This book is published by G. Bridel and Co., Lausanne, and should be obtained by all readers who are interested in the study and teaching of pronunciation. It is the most useful and practical work we have examined, and we specially recommend it because we know of no similar work published in the English language.

As a specimen of the exercises for pronunciation given at the classes, we select the following sentences:—

1. Ce matin, le mâtin, animal mâle à quatre pattes, las, se régala de pâte ; il a tâché de rompre la chaîne qui l'attachait.
2. Jeanne, ma femme, bâtez l'âne, mais ne le battez pas.
3. L'été dernier, c'est vrai, j'étais à Epernay, et j'y retournerai si je reste en santé.
4. Cette belle brebis bêle, il faut la remettre à son maître ; avançant la tête, son agneau la tette.
5. O Eole ! allez, Léo vous hèle.
6. La fête qu'on a faite fut fort belle ; au faîte de la maison du maître, haute de vingt mètres, une gerbe de blé avait été placée.
7. Ne me refuse pas ce que je te demande, te dis-je.
8. Louis, lui, enfouit dans un puits le fruit de son crime inouï, puis s'enfuit dans la noire nuit.
9. Si tu étudies une multitude d'inutilités, ne te ridiculi serais-tu pas ?
10. Dans Namur muré, Muru mourut d'amour.
11. Nos hôtes gravissent la côte dans un haut carrosse rose que tire une sotte rosse qui saute.
12. La brise est molle, quittons le môle ; sortez de votre canot, montez dans le nôtre.
13. Jeune homme, avez-vous déjeuné ?—Non, monsieur, aveugle et miséreux, je jeûne plus souvent que je ne le veux.—Oh ! le malheureux !
14. N'allons point plus avant, demeurons, chère Œnone.
15. Après un bien bon bain, j'absorbai beaucoup de bière brune et de bon pain bis, puis je bus une bien bonne bouteille de bien bon vin blanc vieux.
16. Poisson sans boisson est poison.
17. Gare ! car on distingue les grosses crosses des fusils et les gueules des grands canons.
18. Quand le marquis gris quitte ses grands gants clairs, qui ne regarderait sa bague d'agate ?
19. La reine Didon dîna, dit-on, du dos tout cru d'un très tendre et dodu dindon.
20. Pendant dix ans, le podestat, dur potentat, sordide tyran, domina tout un duché touchant à la douce Toscane.
21. Je viens de voir, au fond du frais et vert vallon, la veuve Favey qui veut faire des vers en souvenir du défunt, le facteur Victor.
22. De la forêt profonde il était l'amant fauve. (*V. Hugo.*)
23. Le vase où meurt cette verveine,
D'un coup d'éventail fut fêlé. (*Sully Prudhomme.*)
24. Sans ces moroses soucis, j'eusse aussi souri.
25. Que coûtent ces six saucisses-ci ?—Ces six saucisses-ci sont de six sous.
26. Servez ces six soles sans sauce et sans sel, six œufs en salade, et six salsifis frits très frais.
27. Pour qui sont ces serpents qui sifflent sur vos têtes ?
28. Tu as raison, c'est la saison du cresson.

Another indefatigable lecturer is Professor M. Maurer, whose addresses are listened to with much attention. He is a linguist of exceptional ability, a practical teacher of long experience in various parts of Europe, an accomplished scholar, and an able exponent of method. We were fortunate in being able to listen to an instructive lecture on "The Application of New Methods to the Study of Modern Languages."

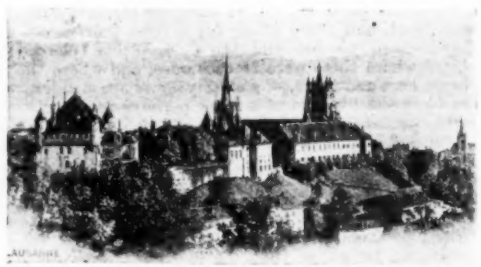
Only a few years ago, said Professor Maurer, instruction in modern languages still dragged along in the ancient ruts of tradition, centuries old. Living languages were taught as dead languages by means of grammar and translation. The ordinary result of long years' study was a certain facility in reciting paragraphs of grammar, in lamely interpreting disconnected sentences or extracts, in knowing by heart lists of words which suggested nothing but the utter boredom experienced in learning them. As for being able to converse or read for pleasure a book in the language studied, that was regarded as an impossible chimera.

Unfortunately for the lovers of routine, the attention of the public was aroused. With a curriculum growing more complex year by year, was it not time to alter these antique methods, to vivify the instruction, to take into account the requirements of practical life ?

The *élite* of the scholastic profession recognised that these demands were well founded, and commenced the work of reform required by the public. The faults of the old methods were speedily seen. They paid no heed to brain mechanism and psychological processes ; they addressed the ear through the medium of the eye ; they connected the foreign vocable with another borrowed from the mother tongue, instead of associating it directly with the thing signified ; they gave abstraction precedence over concrete detail ; they made grammar a collection of recipes, instead of an organising principle which should guide the speaker without his being aware.

How were these defects to be remedied ? Many ingenious minds in Switzerland, Germany, France, England, and the United States have laboured to solve the problem, and some have arrived at solutions which are already revolutionising language-teaching in our educational institutions. The majority of these solutions are derived from the natural method followed by the child in acquiring his mother tongue. He learns to speak in the presence of the things spoken of, and associates directly the word heard with the object which the word represents.

At first the child only comprehends vaguely ; his understanding only grows clear after years of groping ; and thought, charged with manifold experiences, only shows itself still later. Hence there are three stages of development which are to be imitated in the teaching of foreign languages—(1) a period during which the child guesses the speech of adults without speaking himself ; (2) a period in which he speaks, and understands clearly what is said to him ; (3) a period during which, by the aid of reading and writing, he adds to his previous acquirements the faculty of



LAUSANNE.

fixing his recollections, connecting what is present with what is absent, and thus extending indefinitely the limits of his mental horizon.

To these three stages in child speech correspond three steps in language study. For the first step, gymnastic exercises, performed first to the commands of the teacher and afterwards to those of a pupil, are specially suitable. The chief aim in this case is to impress the ear, so generally neglected by our bookish methods, and to accustom the pupil to associate directly, and without intervention of the mother tongue, the movement with the foreign word of command.

Unfortunately, these initiatory processes are as yet little employed by our reformers. On the other hand, the processes which constitute the second step are now in extraordinary favour. The association is direct, as in the exercises of our first step, but they have reference to representations of things rather than to the things themselves. Many new manuals found their lessons upon pictures representing the seasons, town and country life, everyday objects and scenes. Others, not so common, draw inspiration from the ideas of M. Gouin, and instead of pictures take a series of actions expressed in a methodical succession of sentences. Others, again, will perhaps apply to language teaching the admirable object lessons of Paul Bert. We may even imagine some text-book writer of the future combining all these different processes, and thus effecting a decided advance in the application of present-day methods. One last step still remains to be surmounted.

This will bring into play all the forces of the language—the use of synonyms, different significations of words, opposites, periphrasis, "the right word," cause and effect, proverbial and figurative expressions, and the more usual similes. It will likewise include reading, explanation and performance of comedies, debates upon interesting subjects, lessons on the great monuments of literature, history, geography, the institutions of the country where the lan-

guage taught is spoken—all this, of course, *in* the language of the country concerned.

Many teachers, lovers of progress, already make use of one or more of these exercises. The ideal teacher would be he who could succeed in combining them into a practical synthesis, and thus prove that the rejuvenation of the "Humanities" is not a chimerical dream.

THE ELEMENTS OF SCHOOL HYGIENE.

BY ARTHUR NEWSHOLME, M.D., F.R.C.P. (LOND.),

President of the Incorporated Society of Medical Officers of Health; Examiner in State and Preventive Medicine to the Universities of London and Oxford.

SCHOOL DESKS AND SEATS.

AMONG the causes of defective eyesight, badly constructed or arranged desks and seats play an appreciable part, though a less important part than defective books and insufficient lighting of the schoolroom.

It must be remembered that no form of desk or seat will obviate the evils of too long continuance in any one posture. This leads to imperfect expansion of the lungs, with consequent insufficient oxygenation of the blood, and to muscular weakness, showing itself in drooping shoulders, and, if excessive, followed by a partial twist of the vertebral column, which is dependent for its support largely on the tonicity of the muscles of the back. A few minutes' interval during a writing lesson, devoted to arm exercises, is most beneficial in securing good postures.

The bench without support for the back has long since been condemned for children. Without such support, a child will not for long sit upright. The back need not be more than a piece of wood 3 inches broad, slightly tilted back, and so placed as to support the back just below the shoulder-blades. In this way movements are not interfered with, while the spine receives steady support. Liebreich gives the rule that the top of the back of the seat should be 1 inch lower than the edge of the desk for boys, and 1 inch higher than the same point for girls.

In the next place, the child must have feet supported by a foot-board or on the floor. As a German authority (Snellen) has put it, "it is absolutely impossible that a tall and a short boy will both sit equally well on the same seat and at the same desk. It is just as unlikely as that the same clothes would fit the same pupils." And yet it is too common to find children arranged irrespective of length of legs, and some of them consequently exposed to protracted discomfort. The necessity for adapting the height of the seat and of the back-support to the height of the scholar would alone suffice to condemn the long desks so commonly in use, or even dual desks, unless several sizes are contained in the same classroom, adapted to the varying size of the children. Dr. Kerr* measured 1,600 children in five artisan schools in Bradford, and his results showed that 95 per cent. of the school children came within 2½ inches of three selected height groups. The cases requiring seats of exceptional height are evidently therefore comparatively few. It will be convenient at this point to cite the requirements of the Day School Code (1899). Of the first clause of section 14, which runs as follows, we can express unmodified approval :—

"Benches and desks, graduated according to the ages of the children, should be provided for all the scholars, and placed at right angles to the light."

The next clause of section 14 is as follows :—

"An allowance of 18 inches per scholar at each desk and bench will suffice (except in the case of the dual desk), and the length of each group should therefore be some multiple of 18 inches, with gangways of 18 inches between the groups *and at the walls*. A desk for one child needs no gangway next the wall. In the case of the dual desk, the usual length is 3 feet 4 inches, and the gangways 1 foot 4 inches."

It is clear that the above paragraph not only permits the use of the dual desk, but by implication endorses—by assuming the continuance of their use—desks longer than the dual. This is bad from every point of view. It causes too dense congregation of children, aids the dissemination of infectious diseases, and makes it much more difficult for children to assume and retain good postures, thus favouring defective eyesight and twisted spines.

The next clause of section 14 states :—

"(*a*) The desks should be *very slightly* inclined. An angle of 15° is sufficient. The objections to the inclined desk are that pencils, pens, etc., are constantly slipping from it, and that it cannot be conveniently used as a table. The objection to the flat desk is that it has a tendency to make the children stoop. A raised ledge in front of a desk interferes with the arm in writing."

There is great difference of opinion as to the proper slope of the desk. Most authorities are agreed that one slope is required for reading and a less slope for writing. In assuming a fixed angle—which errs also, in my opinion, in being too small—the Code offends against this primary condition. A desk is required the slope of which can be modified according to the work. It must be admitted that unless strict discipline is enforced, and the alteration in position is only permitted to be made at a stated moment in obedience to the instructions of the teacher, considerable noise may be caused by manipulating the hinge. But it is hopeless to expect that one angle will be equally suitable for both writing and reading. Often children are made to stand while reading. This favours the bad habit, to which children are very prone, of bringing the book too near the eyes. This habit is begun in the infants' departments, where it is particularly detrimental, as preparing the way for near-sightedness. For this reason *infants should not be allowed to stand to read*. In order to prevent strain of the eyes, the book should be 10 to 12 inches from the eyes. A moment's consideration will show that in order to maintain this distance while standing, a child must keep his forearm in a semiflexed position—a position which cannot be maintained without strain for more than a few minutes—or he will rest the book against his chest, and bring down his head in a way that interferes with the light and encourages a bad posture. Hence the importance of the above rule as to reading, and, as a corollary, the importance of having a desk which can be sloped to an angle of 30° or 40°.

Next to the provision of a back-rest, and of a sloping surface to the desks, comes the question of relation between the position of seat and desk. Much discomfort arises from lack of adaptation of these to each other. The most important points are the *distance* (that is, the distance between the front edge of the seat and a perpendicular line dropped from the edge of the desk) and the *difference* (that is, the difference between the height of the seat and of the desk). The *distance* should equal zero, or be a small negative quantity; otherwise the scholar, in writing or reading, has to lean too far forward. The *difference* should be adapted to the height of the scholar, if comfort to the scholar and efficiency in his work are to be secured. Robson recommends that it should equal the length of the forearm, or about one-sixth the height of the scholar. The *height of the seat* from the ground must correspond to the length of the scholar's leg from the knee to the sole of the boots.

The preceding conditions cannot be efficiently fulfilled except by single desks, and from every standpoint these alone ought to be allowed. They permit of the scholar writing without raising the elbow or twisting the shoulders; they diminish the risk of contagion; they facilitate efficient ventilation, expose the children to efficient inspection by the teacher; and, what is perhaps even more important from the teacher's standpoint, they prevent the formation of too large classes. The distance that a teacher's ordinary voice will carry has well-defined limits, and single desks therefore tend to keep the teacher's work within manageable limits. The last paragraph of section 14 in the Code bears on this point, though, as already stated, its implied approval of long desks is unfortunate.

* *Journal of the Royal Statistical Society*, September 1897.

Our Monthly Retrospect

EDUCATION IN ENGLAND.

N.U.T. NOTES, ETC.

BY T. B. ELLERY, F.R.G.S.,

President of the National Union of Teachers, 1895–96.

The General Election. No member of the Union will need reminding that the General Election brings Messrs. Yoxall and Gray once more before their constituents. It is assumed by many that the khaki issue alone makes things tolerably secure for the latter, while the friends of the former assert, and no doubt with excellent reason, that he is to-day more popular than he ever was in West Nottingham. But it is most unwise to be too confident. Teachers in both divisions must use every legitimate means in their power to secure the return of the two men who have done so much during the four years they have sat in the House for the teacher and the child. The figures of preceding elections in the two divisions may interest many readers of THE PRACTICAL TEACHER. Here they are:—

W. West Ham.—1885—E. R. Cook (L.), 4,219; J. Forrest Fulton (C.), 3,500. 1886—J. Forrest Fulton (C.), 3,920; E. R. Cook (G. L.), 3,193. 1892—T. N. A. Grove (G. L.), 4,976; Sir J. Forrest Fulton (C.), 4,943. 1895—ERNEST GRAY (C.), 5,637; T. N. A. Grove (G. L.), 4,931.

W. Nottingham.—1885—Col. Seely (L.), 6,669; E. Cope (C.), 3,797; John Burns (Soc.), 598. 1886—H. Broadhurst (G. L.), 5,458; Col. Seely (L. U.), 4,609. 1892—Col. (Sir) C. Seely (L. U.), 5,610; H. Broadhurst (G. L.), 5,309. 1895—J. H. YOXALL (G. L.), 6,088; A. G. Sparrow (L. U.), 5,575.

In the coming contest Mr. Yoxall will probably be opposed by Sir Lepel Griffin, who, in spite of his scholarship and Indian distinctions, will find—so it is believed by many—he has chosen the wrong constituency to fight (and the present writer has personal knowledge—speaking politically—of both Sir Lepel Griffin and Mr. Yoxall). If the former should win, he must thank the khaki cry for his good fortune. In Mr. Gray's case the opponent is, it is said, a strong local candidate with certain claims to favour. But the present member should be safe, assuming, of course, that good work is put in at the time of the election, for he has taken a practical interest in the locality which it would be hard for any man to beat. Nothing has escaped him, and now he has turned his attention to the Volunteer Movement, obtaining a commission, and spending a fortnight in camp with the 3rd Essex. Betting is an unpardonable sin, but if I were a "sportsman" in the betting sense, I think I should put my money on Gray and Yoxall.

Other Candidates. All being well, Dr. Macnamara will soon strip for the Parliamentary fight in North Camberwell, his opponent being Mr. J. R. Diggle. The present member is Major Dalbiac, a most popular man, and one whom the worthy doctor would have found under any circumstances a hard nut to crack. But the gallant major is retiring, so that the personal popularity element is removed. It cannot be said that Mr. Diggle is in any sense an equally good candidate, hence the doctor's chances have immensely improved. His position on the poll at School Board elections shows how he can work his way to the top, and it may be taken for granted that while he will fight the battle fairly and squarely, he will also fight it with great determination. Here again the figures may be interesting:—

1885—R. Strong (L.), 3,137; W. S. Blunt (C.), 2,975. 1886—J. R. Kelly (C.), 2,717; E. H. Bayley (G. L.), 2,352; W. Pirie Duff (L. U.), 246. 1892—E. H. Bayley (G. L.), 4,295; J. R. Kelly (C.), 3,450. 1895—Major Dalbiac (C.), 4,009; E. H. Bayley (G. L.), 3,316; N. P. Palmer (Lab.), 32.

Another candidate for Parliamentary honours is Mr. J. C. Horobin, M.A., of Cavendish College, Cambridge, who has recently addressed a Liberal meeting at Bury St. Edmunds in response to an appeal made to him to oppose the present Conservative member for N.W. Suffolk (Mr. Ian Malcolm), who was returned in 1895 by 5,144 votes to 3,701. It is understood that Mr. Horobin has agreed to contest the seat. That he would be a useful member at St. Stephen's goes without saying.

Union Representation in France and Belgium. The President of the Union and Mr. T. H. Jones, Chairman of the Tenure Committee, represented the Union at the International Congress on Primary Education at the Sorbonne, Paris, afterwards going on to the Conference at Lille. Among the noteworthy incidents were an accident to the President, which compelled him to use a Bath-chair at the Exhibition, and the singing of the Welsh National Anthem by Mr. Jones at the banquet which formed a part of the proceedings of the Lille Conference. All Unionists will be glad to know that Mr. Jackman has now practically recovered from the accident, which might have been a very serious matter.

To the Belgian Teachers' Conference were sent the Vice-President of the Union (Mr. Blacker), and Mr. Harry Coward. It need not be said that they performed their duties with credit to themselves and to those in whose name they spoke.

A Welcome to Mr. T. Butland. Among the many pleasant incidents of the Executive reunion was the return to duty of the veteran of the west, Mr. T. Butland. It may be remembered that he was in the Great Western Railway smash at Slough, as he was returning from an Executive meeting. How he escaped with his life was almost a miracle; he was severely shaken, and has been unable to attend to his duties for some time. His colleagues at Russell Square were glad to hear from his own lips on Saturday that he had now resumed work, and was not feeling the strain to any very great extent. Mr. Butland is as popular in Devon and Cornwall as he is at the Executive Board, which goes to show that a prophet is *sometimes* honoured in his own country.

An Educational Programme. The Executive will doubtless soon be called upon to formulate an up-to-date educational programme. So much of the former platform has been accepted by the powers that be, that it is essential steps shall be taken to secure those further reforms which at one time were little thought of, or were kept in the background until more pressing matters had received attention. The Board of Education's interpretation of the Higher Education Minute seems to call for immediate notice. In the large manufacturing and trading centre of Bradford—the type of place where such schools are most needed—the local educational authority has established a new commercial school. One would have thought the Board of Education would have helped such an institution by every means in its power. But no! It has decided that the school is not eligible for grants under the Minute of the Board of Education, April 6, 1900, establishing Higher Elementary Schools. Is this the way England is to be assisted in the attempt to compete with the foreigner? It seems clear there is to be as little advanced education as possible in the primary schools, all the "plums" being reserved for the secondary schools of which one has heard so much of late.

Surely, for example, the boys in the upper standards of the primary school—boys who are able to pass through

Standards VI. and VII.—are all the better for the training afforded by a little French, Algebra, Mensuration, and so on. But it seems as if all this training will disappear in the near future. At any rate, if it remain, there is to be no payment for it in addition to the general block grant. Educationally it is a mistake, and it is to be hoped, therefore, that the Executive will give due attention to this matter before the next "New Code" becomes law.

The Decimal System. The Executive would be well advised, too, to make its support of the demand for a decimal system of money, weights, and measures a little more real and a little more energetic than it has been in the past. It is all very well to pass pious resolutions at Conference in favour of the reform (the present writer has been able to obtain almost unanimous support for such resolutions on several occasions), but something more is wanted.

The Decimal Association has been doing its best for years, and so far has failed; but it is more than possible that the Union, if it really meant business, could carry the reform in two or three years—five, at the outside. The nation would reap the benefit, and the part played by the Union would never be forgotten. "Owing to the strenuous exertions of the National Union of Teachers, the Decimal System was made compulsory in this country in ——." Such would be the verdict of the historian, and surely no one will deny it is a verdict the Union might well attempt to secure. It is quite true that statesmen of the type of Sir William Harcourt and Mr. Goschen (both past Chancellors of the Exchequer) have said the change is almost impossible—for some time to come, at any rate. But that need not be taken as finally disposing of the question. The writer of these Notes once heard Sir William say: "The change in Germany took place, not in quiet times, but as a result of that great war, and the great change which constituted the unification of Germany." For once in a way "Historicus" was wrong, for far from the change referred to having been brought about by the great war of 1870–71 and the subsequent consolidation of the German empire, the first movement in favour of the metric weights and measures in Germany was actually before 1860. Experts appointed by the various states presented their report in favour of the metric weights and measures in 1861, and in August 1868 an Act was passed which made it optional to use these weights and measures as from January 1870, and which made it compulsory to use them as from January 1872.

There are difficulties in the way, of course, but they are not so great as those which had to be surmounted before superannuation was an accomplished fact. The great Chambers of Commerce, the leading School Boards, and the vast majority of scientific and commercial men are in favour of the reform. Let the Union now step in and confer a benefit upon the nation, the importance of which could hardly be exaggerated. Will the Executive please note?

School Boards and Teacher Members. School Board elections will soon be upon us. The splendid work done by the teacher members of certain Boards ought to be sufficient to ensure their re-election; but members of the Union know from past experience nothing can be taken for granted in such matters. Take the case of Mr. Peaker and the Leeds School Board. No one doubts that his defeat, when he stood for re-election, was due as much to over-confidence on the part of supporters as to tactics more or less generous and reputable on the part of opponents. It is understood he will again offer himself at the next election. If that is so, the Leeds teachers must not cease their efforts, when once the fight has begun, until the declaration of the poll. Mr. Wardale of Manchester, Mr. Ansell of Birmingham, and Mr. Cryer of Bradford—and there may be others—will also face the electors, and will undoubtedly be re-elected if those most concerned do their duty.

Let every effort be made to return each of them at the top of the poll. Large classes, salaries, apparatus, buildings, and many other questions can only be effectively dealt with when a teacher stands up and speaks from the experience he has gained by long service in the schoolroom.

The Birkdale Difficulty. Readers of the "Organ" of the Union will have seen that there has been danger of the whole question of the retention or resignation of Mr. Syddall being reopened. Indeed, before these lines are in print, the difficulty may have reached an acute stage. Mr. Syddall and his friends would have been well advised to accept the vote of the Board, for even if their present tactics should prove successful, there can be no doubt as to the ultimate result. The late headmaster, Mr. Mortimer, was, in the opinion of the Executive of the N.U.T., capriciously and unfairly dismissed.

That being so, only one course was open to the Union. That course has been followed, and Mr. Syddall would indeed be "playing the man" (to quote a phrase he has used from a letter of the late Mr. Mortimer to himself) if he sought a post elsewhere, and thus allowed the work of the Birkdale School Board to go on as it ought to go on. It would be a pity if the next School Board election in that town were fought upon the question of his retention. And it would be unfortunate—for Mr. Syddall.

Superannuation in the Isle of Man and in Jersey. Teachers in the Isle of Man and Jersey have to thank the N.U.T. for the Superannuation Act of 1900, which extends the provisions of the Elementary School Teachers' Superannuation Act of 1898 to teachers serving in those islands.

The Jersey Association has lost no time in conveying to the Executive of the Union a vote of thanks for the work done in "pushing to a successful issue the Supplementary Pension Bill."

Clause II. of the Isle of Man Act (there is a similar clause in the Island of Jersey Act) runs as follows:—

"Recorded service in the Isle of Man shall not be reckoned as such service for the purpose of annual superannuation allowances or disablement allowances under the principal Act, unless provision is made and maintained to the satisfaction of the Treasury by the legislature of the Island:

"(*i*) For the grant and payment of any such allowances in the case of a teacher, the whole of whose recorded service has been service in the Island, by the Government of the Island out of Island funds instead of by the Treasury; and,

"(*ii*) In the case of the grant of any such allowance to a teacher whose recorded service has been partly service in the Island and partly service elsewhere, for the repayment to the Treasury out of the Island funds of a part of that allowance proportionate or assignable to the period of that recorded service in the Island."

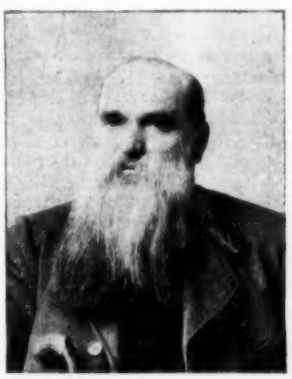
EDUCATION IN SCOTLAND.

E.I.S. NOTES, ETC.

BY JAMES PATERSON,

Ex-Vice-President of the Educational Institute of Scotland.

Death of the President-elect, E.I.S. THE startlingly sudden death of Mr. Mackenzie, the President-elect of the Educational Institute of Scotland, came as a great surprise and shock to the teachers of Scotland, who were looking forward to his occupying, within a very few days, the presidential chair. His death at this time will be specially regretted by teachers in the Highlands, who felt gratified that the profession in the far north was about to be honoured in the person of Mr. Mackenzie as it had never been before. For many years he had been one of the representatives of the Highland counties in the General Committee of Management of the Institute, and no one could have been more regular in attendance, or more faithful in looking after what he considered the special interests of his constituents.



MR. A. C. MACKENZIE.

His genial and gentlemanly manners and his hearty laugh and handshake made him popular wherever he went, while his upright character led to his being esteemed and respected by all who had the honour of his acquaintance. His patriarchal presence and his kindly counsel will be much missed in the committees of the Institute, over which, it had been anticipated, he would have presided with ability and dignity.

We have already presented our readers with a brief account of Mr. Mackenzie's professional career, in the April number of this journal, when announcing his election to the office of President.

Departmental Appointment. Mr. George Macdonald, M.A. (Oxon.), has been appointed by Lord Balfour of Burleigh to act as assistant director of higher inspection and of the Leaving Certificate Examination. He will, however, retain his present appointment of Lecturer on Greek in the University of Glasgow. Mr. Macdonald is a son of the late Dr. James Macdonald, rector of Ayr Academy.

Higher Education in Scotland. Sir Henry Craik has presented his ninth special report on the inspection of higher class schools in Scotland. The number of these schools inspected during the past session was eighty-seven. The annual inspection, Sir Henry reports, had applied a stimulating criticism to all the schools, had given rise to a healthy public opinion in regard to them, and had, in combination with the Leaving Certificate Examination, made it impossible for a school to maintain its place if it failed to keep in touch with the general advance in efficiency. Sir Henry again expresses his regret at finding the pupils withdrawn at too early an age to profit fully by secondary instruction. This he considers to be one of the most serious difficulties with which secondary education in Scotland has to contend, and the only remedy, he points out, lies in the growth of a more enlightened public opinion.

A Hindrance to Secondary Education. Sir Henry Craik calls attention to a serious hindrance to the efficiency of pupils going from State-aided to secondary schools through the schemes of instruction in the two classes of schools not fitting into each other. He suggests that the desired adjustment might, to some extent, be effected by the higher schools delaying somewhat the stage at which the subjects of secondary education are taken up, and giving more time to the perfecting of their pupils of from ten to twelve years of age in English and Arithmetic. He has good reason to think that by following this course the ultimate progress of the pupils in secondary subjects would not be retarded. The managers of the higher schools would find it to their advantage to make some provision for giving such pupils special training when they are first drafted into the schools.

Teachers' Salaries. The Scotch Education Department is setting its face determinedly against the practice, still to be found, of Boards "farming" their schools, or, in other words, paying their teachers by a certain proportion of the various grants earned. The Department declines to allow this in future, and points out that it is contrary to Article 17 (*b*) of the Code to permit a master to conduct a school and share the rise and fall of the proceeds. This action on the part of the Department is rapidly leading to the payment, in all cases, of fixed salaries.

Settlement of the Callander Case. At a recent meeting of the Callander School Board a communication was submitted from the Scotch Education Department nominating three members to take the place of those who resigned owing to the Board's resolution to dismiss Mr. Anderson, the rector of the M'Laren High School. The Board, as reconstituted, agreed to reinstate Mr. Anderson, and the school has since been reopened under his charge.

Drawing and Manual Occupations. The following reply from the Scotch Education Department, as to sewing and manual occupation for girls, may be of interest:—"I am to state that if the time of the girls is already fully occupied, it is neither necessary nor desirable that they should take the additional manual occupation. But the general grant to the school is made on the understanding that the girls are satisfactorily instructed in needlework, and the additional grant under Article 19 B. (4) of the Code will, in that case, be made on the attendance of the boys only."

Superannuation. In view of the near approach of a general election, the Superannuation Committee of the Educational Institute, considering that the following amendments on the Superannuation Act are urgently required, recommend that these should be pressed by the local committees on all parliamentary candidates:—(1) Raising of the pension of the "existing" teacher to the level of that of the "future" teacher by an increase of government allowance; (2) extending the provisions of the Act to teachers in State-recognised secondary schools; (3) providing for the optional retiral of women teachers at fifty-five years of age; and (4) making the pension bear relation to the income of the teacher. The Superannuation Committee, being of opinion that superannuation carries with it the right of teachers to reasonable security of tenure, recommend that this also should be pressed.

Scottish School Boards Association. The executive committee of the Scottish School Boards Association has adopted the following resolutions in regard to the Higher Education (Scotland) Bill:—(1) That on the local higher education committees, which are to be created under the Bill, School Boards should be represented in proportion of at least one-half of the total number of members on the committee; (2) That the benefits of the Act should be extended to advanced departments of elementary schools; and (3) That the only satisfactory solution of the questions raised by the Bill is to enlarge the areas for administration of educational affairs, and to constitute one authority within each area, with entire control of elementary and secondary education.

NOTES FROM THE NORTH.

The September Meetings. As "the Saturday after the third Friday in September" this year falls as late as the 22nd, it will not be possible for us to give this month an account of the September meetings to be held in Edinburgh; we hope, however, to devote some space to them in the November issue. There is at present no indication of any one question absorbing the interest of the delegates at the annual meeting of the E.I.S., as the year just closed has been one of quiet yet satisfactory progress. The retiring president's address, we have reason to believe, will be devoted largely to consideration of the Higher Education Bill, which had to be dropped last session on account of the opposition given to several of its clauses, and consequent want of time for its adequate discussion.

New Science and Art Minute. Circular 296, with its accompanying Minute of August 24, sets forth the conditions of grant for science and art instruction, and is intended to replace the conditions of Section lvi. *seq.* of the Science and Art Directory, and also those of Section xliii. in so far as the latter apply to classes in secondary schools in Scotland.

It is to be noted that the conditions apply to higher-class schools, as defined by the Education (Scotland) Act, 1872, and to such other schools giving a general education to pupils over twelve years of age as are not in receipt of grant under the Code. They do not apply to evening or other classes giving instruction in special subjects only. Grants to these continue to be regulated by the Science and Art Directory of 1899, as modified by the Minute of January 29, 1900.

Conditions of Grant. The Minute provides:—

"That in the case of higher-class schools or other similar schools not in receipt of grant under the provisions of the Scotch Code, the conditions of grant from the sum of money voted annually by Parliament for instruction in science and art in Scotland shall be as follows:—

"I. The managers of any such school may submit a scheme for the instruction of the pupils in—

"*A.* Physical and natural science.

"*B.* Drawing (which may include modelling).

"*C.* Practical geometry and educational handwork of any approved form.

"*D.* Cookery, laundry work, dressmaking, or other form of practical household economy.

And such scheme, when approved, may be made the basis of grants in accordance with the following regulations:—

"(*a*) No scheme will be approved under this article unless the Department is satisfied that the curriculum of the school makes due provision for the instruction of the pupils in the other main branches of a general education.

"(*b*) No grant will be made on account of the instruction of any pupil in *B*, *C*, or *D* who is not under regular instruction in *A*, in a course which satisfies the conditions of the next following sub-section.

"(*c*) No grant will be made on account of instruction in *A*, unless (1) the time-table of the school provides for a satisfactory amount of instruction in mathematics (including higher arithmetic), and (2) due provision is made in properly-equipped laboratories for experimental work on the part of the pupils in courses approved by the Department.

"(*d*) The minimum number of hours per week recognised for a grant in *A* shall be three hours, of which not less than two shall be occupied in practical work.

"(*e*) No grant will be made for *C*, unless, on the one hand, it is related to instruction in mathematics, and, on the other, exemplified in its application to some practical purpose.

"No grant will be made for work in wood, iron, cardboard modelling, or other similar occupation not preceded or accompanied by instruction in practical geometry.

"(*f*) For theoretical instruction in any of these subjects the number of pupils must not exceed forty, and for practical instruction twenty; a laboratory assistant, however, is to count for other ten.

"(*g*) Practical instruction must be given in lessons of at least two periods' (1 hr. 20 min.) duration. Time-table must show sufficient time for laboratory preparation by teacher.

"(*h*) Teachers' qualifications must be proved to the satisfaction of the Department. Eventually, for teachers of science, a degree in science will be deemed necessary.

"(*i*) Pupils must be over twelve years of age, or must have obtained the merit certificate or given proof of equivalent attainments, before their attendances count for grant."

The accompanying circular explains, with regard to the above, that the amount of training in the methods of experimental investigation can only be moderate in the earlier years of the pupil's course; but a minimum of three hours is laid down, as that is considered the least in which it can be expected that satisfactory results will be obtained. It is left to each school's experience to determine how far the minimum may be exceeded. With regard to pupils at or over fifteen years of age, it is hoped that their attention will be concentrated more and more upon the science side of their work.

It is left to managers and teachers to submit courses of instruction, but my Lords trust that the interests of different classes of pupils will be considered, and, in particular, that great attention will be given to the framing of courses suitable for girls in mixed schools.

Under *A*, a course, *either* in physical *or* in natural science, may be submitted, provided it is essentially a course of experimental investigation. The course should include some study of the fundamental facts of physics and chemistry (physics preceding chemistry), while a certain initiation into the study of natural science may be provided for by field excursions, and discussions in class of the observations made.

Theoretical instruction should be explanatory to such an extent as may be necessary, and that only, of the results arrived at in the practical work. The practical should precede the theoretical.

In *B* and *C* there is to be a distinction between drawing as an art subject and drawing as an application of geometry.

The value of the instruction is to be judged by inspection and examination, and for this purpose a record of work is to be kept. Separate registration is not demanded.

Scale of Grants. When the conditions mentioned above are fulfilled, and when the Department is satisfied, on the report of its Inspector, that the profession of work has been satisfactorily carried out, certain grants, which we show below in tabular form, will be given:—

Grants.	*A*. Physical and Natural Science.	*B*. Drawing (which may include Modelling).	*C*. Practical Geometry and Educational Handwork.	*D*. Cookery, Laundry Work, Dress-making, or other form of Practical Household Economy.	Exceptions.	Notes.
Normal Grant.	10s. per hour per week.	5s. per hour per week.	6s. 8d. per hour per week.	6s. 8d. per hour per week.	1. In *A* no attendances to be reckoned in any week for pupils not making the qualifying number of hours for that week. 2. Attendances for theoretical instruction alone in any one week not to be reckoned.	Normal school year is 40 weeks. Therefore the numbers on which the grants for each course are to be calculated will be determined by adding together the number of hours of attendance made during year and dividing by 40. Instruction in each course must extend over whole school year.
Additional Grant.	5s. per hour per week.	——	3s. 4d. per hour per week.	——	Not less than eight hours per week must be given to *A* by pupils claiming this grant.	This grant is only on account of further attendance of pupils who have successfully completed a two years' curriculum and been in attendance for not less than 300 hours at the course of instruction in *A*, or in *A* and *C* conjointly.
Increased Grant.	1s. per hour per week.	6d. per hour per week.	8d. per hour per week.	8d. per hour per week.		Given if inspector reports work to be of conspicuous merit.
Diminished Grant.	One or more tenths.	One or more tenths.	One or more tenths.	One or more tenths.		Diminished for unsatisfactory work, defects of equipment or organisation, or failure to meet requirements.
Reduction of whole Grant.	May be made by the excess (if any) of grant over income of the school as a whole from local sources (including income from rates, subscriptions, endowments, and contributions from local taxation funds administered by various bodies, but exclusive of income from fees).					

The grants are to be given on condition that a fixed salary is paid to the teachers of the classes for which a grant is sought, either in respect of their work in these classes, or their work in the school as a whole (but exclusive of any employment in evening classes held in the same or other schools); and any grants received are to be paid into the school account, and are to be used by managers for improving the efficiency of the school.

Existing schools of science have the option of obtaining grants for session 1900–1901, either under this Minute, or under the provisions of Section xvi. *seq.* of the Science and Art Directory.

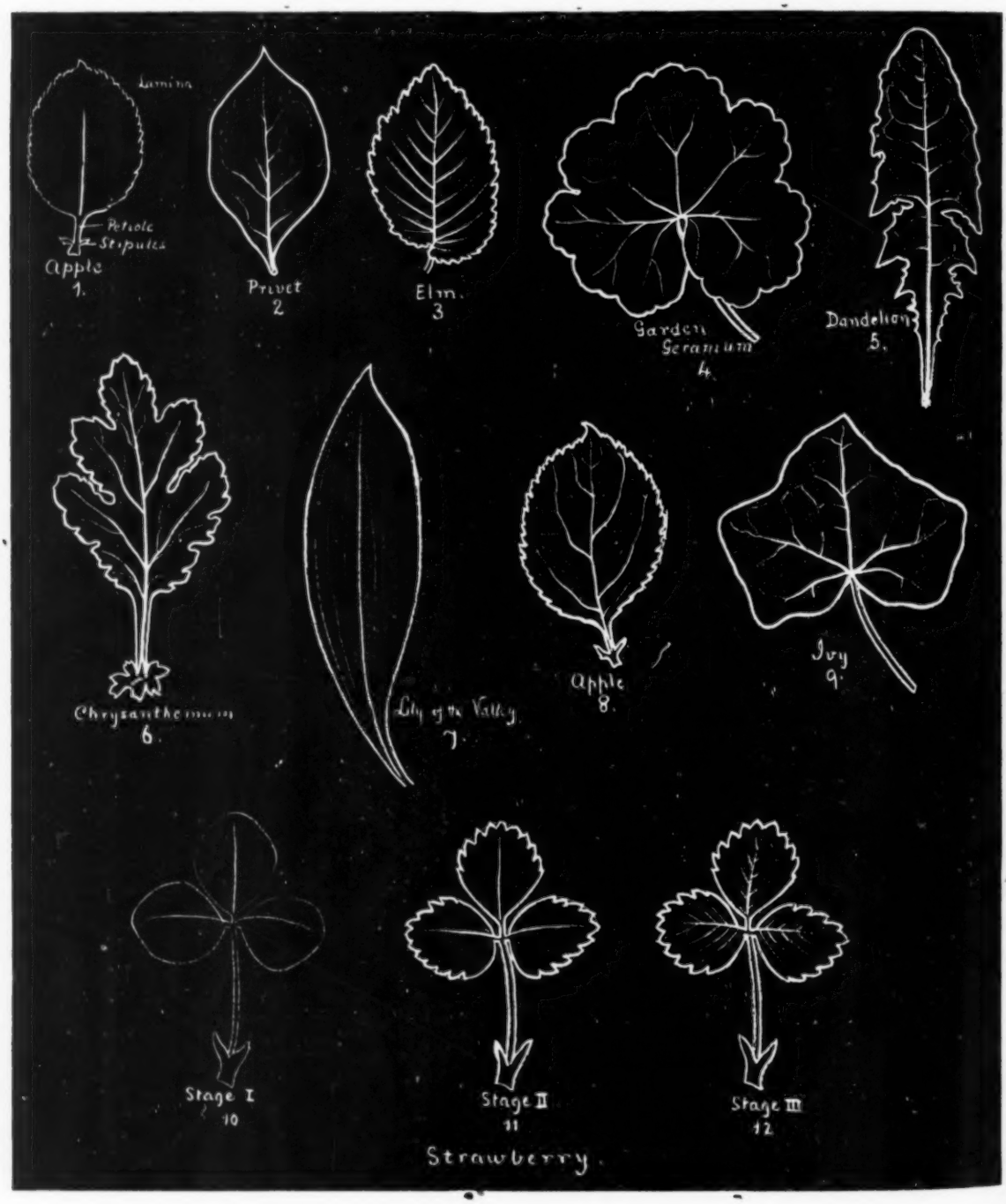
BLACKBOARD DRAWING.—LEAVES.

BY EDITH E. BAMFORD, ART TEACHER, EDGE HILL TRAINING COLLEGE.

VI.

OFTEN during nature lessons blackboard sketches of leaves are required. If a single leaf is to be drawn, not showing its attachment to the stem, there is little difficulty; for it may be sketched without any foreshortening, as if it were placed flat against the blackboard, and with a few skilful touches a good effect can be produced. But should the arrangement of the leaves on the stem have to be shown, considerable skill will be required, for the foreshortening of some of the leaves must be represented.

There are certain important points to know and to notice



before attempting to sketch leaves, or the sketches will be characterless: botanical students would be on the lookout for them, but others would probably not observe them.

When sketching a single leaf, its three parts should be examined (Fig. 1):—

1. The lamina or blade.
2. The petiole or leaf-stalk.
3. The stipules or outgrowths at the base of the leaf-stalk. In some types the petiole and stipules are absent.

There are three important points to observe in the lamina:—

1. *The General Shape.*—This varies very much. In some types it can be represented by a simple form—an ellipse, oval, or circle.

2. *The Edge.*—This may be (*a*) entire—examples, wallflower and privet (Fig. 2); (*b*) serrate, having sharp teeth pointing to the apex—example, elm (Fig. 3); (*c*) crenate, having rounded teeth—example, garden geranium (Fig. 4); (*d*) dentate, having sharp, irregular teeth—example, dandelion (Fig. 5); (*e*) lobed, having deep indentations—example, chrysanthemum (Fig. 6); or (*f*) the indentations may go down to the midrib, making a compound leaf—example, strawberry (Fig. 12).

3. *The Veining.*—There are two principal types:—

(1.) Parallel-veined leaves, in which the chief veins run parallel to each other—examples, iris and lily of the valley (Fig. 7).

(2.) Net-veined leaves, in which the smaller veins form a fine network in the leaves. In this type the veins are all connected; they branch, but the branches unite. Such joinings, however, cannot always be shown in the sketch. There are two varieties of the net-veined type: (*a*) feather-veined leaves, which have a central midrib, from which strong veins are given off in a feather-like manner—examples, beech, lilac, poplar, apple (Fig. 8); (*b*) radiately-veined leaves, which have strong veins radiating from the attachment of the petiole—examples, ivy and sycamore (Fig. 9). In the two latter types it should be noticed that the larger veins generally go towards the centre of the large leaf-lobes.

It is the recording of these important points here enumerated that will give character to the sketch. It is not necessary, however, to make a faithful and exact copy of the leaf selected as the model; this would be a waste of time, for some of its details may be peculiar to the one leaf and not to the type: but the most important typical characteristics with regard to shape, edge, and veining should be carefully noted and recorded.

When sketching a single leaf, take a typical leaf as the model; then proceed as follows:—

1. Sketch very faintly the general shape of the blade, stalk, and stipules (Fig. 10).

2. Sketch with a hard line the characteristic edge of the blade over the faint outline, and also harden the other parts. Do not trouble to clean out the faint outline where it is not covered by the margin, as it will not show in the distance (Fig. 11).

3. Hold up the leaf to the light, and observe the direction of the principal veins. If a central vein, from which others branch, is present, it is the thickest, and the successive branches become gradually finer. The edge of the chalk should be used for the veins, and as each vein is finest towards the margin of the leaf, the stroke should be begun there very lightly, the pressure being gradually increased as the vein thickens.

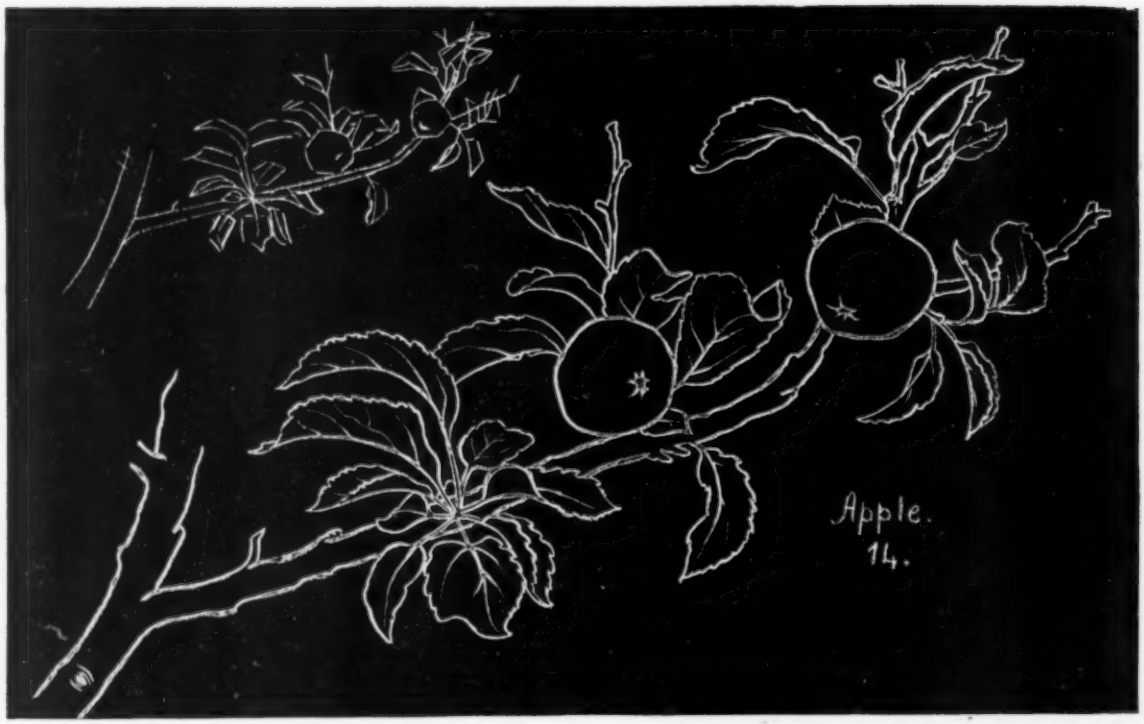
Two examples—the poppy and apple (Figs. 13, 14)—are given to show the method of procedure when the growth and arrangement of the leaves on the stem are to be represented. A typical branch should be selected for the model, and placed in the normal position of growth. A few lines to show the direction of growth, and to indicate the stems, should first be sketched. Next the blocks should be drawn to give the position and general shape of the leaves, as when sketching a single leaf, though here some foreshortening has to be considered. These first stages are shown in the two small sketches (Figs. 13, 14). Half clean out the blocking with the duster, so that only a faint impression is left; then with a hard line sketch in the outline of the stem and the lobes and notches of the leaves, noticing carefully the attachment of the leaves to the stem. If possible, sketch in this last part without using the duster, for an exact copy of detail is not necessary; only the characteristic points need be recorded.

The first examples of plants and branches selected should be climbers, such as the ivy and Virginia creeper, where there is only a slight foreshortening of the leaves; afterwards plants and branches with leaves of simple form, as the pink, chickweed, and privet; and then more difficult examples, as the gooseberry, sycamore, and horse-chestnut.

WITH BLACKBOARD ILLUSTRATIONS,

NATURE LESSONS FOR INFANTS,

will appear next month.



OBJECT LESSONS IN HISTORY.

II.—LONDON'S MOST ANCIENT HIGHWAY.

ON no account should a poet allow himself to be born in a city, Jean Paul Richter used to say; and without doubt it would be better with us all, poetic and prosaic alike, if the place of our birth had been as far as possible from either *the* wen of civilisation, as Carlyle was wont to call London, or any other of the wens that now abound.

But when the inevitable has happened, there is nothing left but to make the best of it; and till the time comes when all children are brought up in fresh air, we may supply them early with the stimulus that all ancient towns afford, and so help them to enjoy life as much as possible.

But notwithstanding this very decided opinion, which is ours as a rule, we almost parted with it a few days ago, when piloting a group of healthy suburban girls through London's most ancient highway, the Borough, to the church of St. Saviour's, Southwark – the subject of our last paper. Threading our way through the High Street, on the hottest day of this hot summer, we almost began to repent of ever suggesting that the poor little children of these parts should be troubled with history at all. How can the denizens of those close, crowded courts and alleys, and of those painfully monotonous blocks of dwellings, take any interest in what does not give physical pleasure? If any of them do, they rise far beyond the average of their fellow-creatures, and may well make most blush. But for the exceptional little slummer, and for those better placed, who are yet within walking distance of this most historic spot, and for those still more fortunate who can visit it by a tram-ride, there is a very shrine of history here, which antiquarians from the ends of the earth are delighted to visit.

Before starting with our group of scholars for this object lesson, we must let them revise the history lessons which were given last month on St. Saviour, the collegiate church of our paper. And we should do well to give additional talks on the Tower, the Pool of London, Old London Bridge, Simon de Montfort, the House of Commons, Gower and Chaucer, Queen Elizabeth's days and the Armada, and her great poets, and the bull-baiting and bear-baiting of her times, the old law of sanctuary, and the bad old laws respecting debtors. And to join modern history to all this, we may tell the tale of Charles Dickens's life and work, and also, what will be personally interesting, the history of general primary education, illustrated by the life of Joseph Lancaster. Many pictures are to be had that make these lessons very vivid; we have given a few here as examples.

Thus well equipped, we may begin our journey at either end of **the Borough**; and as in such a busy place it will be difficult to group the objects we have come to see in their chronological order, we shall be obliged to take them as they are passed, and classify them when back at school to-morrow.

Let us begin, then, at the middle of London Bridge, casting our eyes at first towards **the Tower**, over there on the north-east bank. There the building has stood, guarding London and its Pool, which lies before it, ever since the days of William the Conqueror, whose Norman White Tower within is still intact. The Tower Bridge beyond is a very modern masterpiece of bridge-building—a thing quite undreamt of when the Conqueror made himself master here. Look! there is the new bridge now dividing, and the carts and horses and people are standing still on the approaches, whilst a high-masted vessel goes through; and now it closes, and the heavy traffic is resumed. Enough this to make William's hair stand on end, if he were to walk the earth again, and had not been kept *au courant* with human affairs since he took part in them. And over there, on the south-eastern shore, is St. Olave's Church, which dates back further than the Conquest; for it commemorates the coming of King Olaf of Norway to help Ethelred against the Danes, just as St. Magnus on the opposite bank commemorates his son of that name. It was Olaf who fought in the battle of London Bridge in 1008, and who lashed his ships to its wooden supports, whilst the Danes, who held the bridge, hurled missiles from above. At last the whole structure fell, and great numbers were drowned. The old church now stands solitary amid the ugliness of wharves and warehouses and toiling millions; and we hear that at last the religious services have been discarded. Its rectors discarded the rectory long ago. They bore the strain of modern life as long as they could; but

when one morning the increased traffic on the river sent into the dining-room the mast of a ship and spoiled the rector's coffee, the best of men could stand it no longer, and the rectory was deserted.

But before leaving London Bridge, let us remember that it perhaps, of all objects, most crystallises the chief facts of our past history. It has not only been a battle-place, but it has represented most intensely the impulses and progress of our national life; not this particular bridge, of course—this only dates from 1831—nor its immediate predecessor, but those before them, and there have been many. In the Middle Ages there stood here tall houses and a church; and till the reign of George the Second it was the best place to buy pins and divers other little things belonging to the toilet. Let us now try to throw ourselves back into the Middle Ages, and watch for a few minutes that merry band of pilgrims who are on their way to Canterbury to confess their sins at the shrine of St. Thomas à Becket. They are entering the beautiful little church dedicated to this favourite saint of London sinners, to implore his protection on the way and back. We will leave them there awhile, for we shall meet them again presently; and in the meantime let us project our minds into the sixteenth century, when Henry the Eighth was king, and one Edward Osborne is an apprentice of a prosperous cloth-worker residing in that tall house opposite, where he carries on business. Hark! there is a hue and cry. What is the matter? The cloth-worker's little daughter has fallen from a window into the river below, and the brave young apprentice is diving headlong after her before the rapid current shall carry her away. And the father is beside himself with grief, when the brave lad reappears with the child, and a boatman takes them up. The grateful father, of course, promises his daughter in marriage when old enough, if her rescuer so desires; and later on these young people do marry, and become the founders of the present ducal house of Leeds.

Besides this romantic tale, we must tell of other things that have happened here. Later than the time of the faithful apprentice, though not very long after, a famous house, called **Nonsuch**, was brought over in pieces from Holland, and pegged together over the seventh and eighth arches, and by means of an archway was carried right across the bridge. It was, of course, one of the sights of London, as was the bridge itself, being then the only one; and visitors from the country would pause to gaze at the Traitors' Gate, just to the south of **Nonsuch House**, where on poles were withering the heads of unfortunate men whose opinions had run counter to those of their countrymen. Whose were they? In one reign could be seen the head of brave Sir William Wallace; in another, Sir Thomas More's; and later, Guy Fawkes's; and still later, the co-workers of Oliver Cromwell. And below the showhouse there was a drawbridge, for only on the south were the citizens afraid of an enemy's coming, and the heads on the poles were for a warning to them. Let us picture Wat Tyler and his men advancing to claim popular rights, and let us watch them when Sir William Walworth, residing at Fishmongers' Hall, at the other end, meets them, and with a blow from his sword unhorses the brave Wat (you may see that sword in the present hall to-day, and the pall of Sir William also).

There, too, came with great pomp and pageant that "Harry the King" whom the populace turned out to welcome as the hero of Agincourt. But we shall never end if we are to give even the leading features only of this old bridge's history. We will, then, keeping our eyes southward, and leaving the enchanted spot, note down, there on the right in Bankside, the old church of St. Marie Overie, in whose churchyard there is still the *tesseræ* of Roman London, as it has been for these fourteen hundred years and more, and where, too, lie the ashes of men who witnessed all we have told of the bridge. Standing opposite the church, let us live back in 1265, and ask who is that fine soldier on a prancing steed, at the head of a number of stalwart followers. No other than Simon de Montfort, who lives there in the lane by the riverside—**St. Olave's Lane**, now contracted and perverted into **Tooley Street**. They are going to march over the bridge to address the king, and to force him to constitute our first House of Commons. De Montfort looks like success, and he obtains it; and we are duly thankful, and feel deeply respectful to Tooley Street for having had such a resident. Long, long after, but possibly animated by his memory, the nine tailors of Tooley Street began there their petition to the king, about some wrongs then suffered, with the preamble, "We, the people of England."

We cannot stay now to go into Stoney Street, which, as its name implies, is an old Roman way, but we can, in fancy, people it in Elizabeth's days with Shakespeare and his friends, who are strolling through it to the bear-gardens, where the Southwark folks are disporting themselves with bear-baiting; and we can stand aside on a bright morning to watch the great queen go by to Tilbury Fort, from whence our fleet is to set out to end the days of Spanish greatness and to begin our own.

Next we turn to St. Thomas Street, where once stood the religious house which gave it its name, with its little hospital—the germ of that which now stands on the Albert Embankment, and is of universal fame. Opposite to its site still stands Guy's; and now we may introduce a little tale of parsimony to match that of old John Overie. The founder of Guy's was a coal merchant, successful and penurious, who when quite rich made up his mind to marry his housekeeper, to save the expense of a cook perhaps; but before the day fixed for the marriage, Mr. Guy, looking from his window, espied the housekeeping lady deposit a plate of broken food in a convenient corner for passing dogs to eat. This so much vexed the soul of the stingy one that he retracted his promise, and diverted his fortune to the founding of this time-honoured hospital, perhaps the first outside a religious house. The evolution of charity apart from religion is an interesting point to notice in the progress of the ages, but not for the child; the abstract is not for him at present.

We now turn our steps back for a few hundred yards, and are again in the main street; and we turn our minds back also, and see a country-like road, with inns here and there, and we pass by the house of "the moral Gower," whom we left sleeping in his tomb last month at St. Saviour's: he is an elderly man leaning over his gate and watching those Canterbury pilgrims, whom we left in St. Thomas's Church on the bridge, coming along in right merry form. We will watch them too; there are twenty-nine in all, and they are going to put up for the night at the Tabard Inn. You may see the inn **yard** to-day, and a house at the corner with the sign of the Tabard (a knight's coat) swinging from it; but this is only to commemorate the old inn, which disappeared about forty years ago. What were the antiquarians about then that they let it go? To this day, however, the King's Head, the Catherine Wheel, and the Queen's Head give some idea of what the old inns were like. The Queen's Head has, or had lately, the old wooden balcony still intact from which knight and lady, friar and nun looked out on the antics of the strolling players below. Although the Globe, and Shakespeare, and Beaumont and Fletcher were hard by, the pilgrims loved the fun in the inn yard after the evening meal. The children can see by a look at the old balcony that its purpose was for these entertainments.

But let us enter the Tabard with the pilgrims. Side by side we walk in with the quiet man-of-law, and the chattering wife of Bath, and the franklin, and the reeve, and the pardoner who owns the veil of Our Lady, and has a batch of pardons "all hot" from Rome, and the confessor who shows for the bones of saints some from a pig, and the knight, and the nun, and Madame Eglantine, who keeps a school for young ladies, and teaches them "Stratford-atte-Bowe French." All these, with their virtues and their failings, inherent then as now, are depicted for us by the gentle Chaucer, who walks in apart from them, and is "the chiel among them takin' notes." He makes that evening live perpetually; he shows us Harry Bailley, the host, receiving his guests, and later in the evening standing in the eating-room leaning against *the post of honour*—that is, the post in the middle supporting the ceiling—and proposing to his guests that when they start to-morrow for Canterbury, each should be prepared with a tale to tell *en route*, that the time may pass right gaily, and that he should accompany them to be arbiter of these tales, and on the return a lordly supper should be prepared, at the cost of all, for the honour of the

one whose tale should secure the first place in his estimation. And so we have *The Canterbury Tales*, which, the learned tell us, are a more vivid picture of mediaeval life than any other European country possesses. As told to the children, they at least make this old neighbourhood live again in other times and in other manners.

But we must hurry on, before we tire, to the church of St. George the Martyr, only noting on the way one or two house signs still remaining from the days before we gave numbers to our houses.

See, there is the church we seek—of most ancient foundation, but that is not the reason why Dickens wove around it the life of Little Dorrit. She, the children will remember, was born in the Marshalsea, the old debtors' prison next to the church. In it was imprisoned Charles Dickens's father (Mr. Micawber), and to the dingy building Charles would often go when his work was over at the blacking factory. Poor boy! no wonder he knew so much about the inmates, and could write so well of them and their children, and all that made up their lives. When visitors' hours were over, the young genius would cross the road to mean Lant Street, there to ponder in his poor lodging over all he had seen and all he meant to do. Many of the prisoners lie in the churchyard, which is now open to the public; and there, too, lie Bishop Bonner, Morland the artist, Cocker of arithmetic fame, and Tate of the Tate and Brady version of the Psalms. And the church steps are the same as Little Dorrit stood on for a while to view the stream of life below just after she had been married at the altar within. Marshalsea Road, opposite, is a new road commemorating the prison, and succeeds to the old Mint, which had been a place of sanctuary, where Jack Sheppard and others had defied all comers, and long after laws of sanctuary were abolished this place continued to be a menace to the police.

Was it as the result of all this that a lady of the parish made in it the first attempt at public elementary education, long before Joseph Lancaster was born? He curiously, and possibly in consequence, commenced his first school, the germ of our modern elementary system, over there in Kent Street (now Tabard Street), also in this parish, in the last decade of the eighteenth century. Through that old street all historical processions had passed from the earliest days of our history, and the latest honour is its crowning point. Poor old street! it has a sad name, for all that; but it seems it is to be effaced or renovated: if the latter, the street of history will have a brand-new chance.

Let us here step back a few paces and continue our walk further south in the High Street, and passing Lant Street, look out for the curly-headed novelist, still a boy. He is out for the air; let us join him as he strides on to St. George's Fields, where the suburbs then began. He is looking animated. What does he see? He is seeing with inward eye the events there of fifty years before, when Lord George Gordon and his hosts met one May morning; and he is following their movements, and is realising as only a genius can all the horrors of the next three days, and he means to tell it all as he sees it, and as he has heard old people talk of it, in such form as will make him famous. Barnaby Rudge shall be the hero, and everybody shall read the book. And it all came to pass. Before we leave the embryo novelist, how we wonder if he knows that, just by where the Borough Polytechnic now stands, in that same violent time stood a little house where was born the boy who was to make it possible to give Charles Dickens's books millions instead of thousands of readers. The Polytechnic, formerly the Borough Road Training College, commemorates the spot where Joseph Lancaster was born, and the street on its east side bears his name. The children owe so much to him that they should be taken inside the building to read the memorial tablet; and in retracing our steps back to the Borough, we can show them the municipal buildings, with their grounds given up as a play place to the children of the neighbourhood. This was formerly a county jail, but was closed with several others some time ago, as the spread of education, begun by Lancaster and others, is enabling us to close our prisons instead of increasing their number.

Well, we think our wander-hour must end here. Much, very much more, might be told of the streets we have seen, but enough perhaps has been given to interest any child, and especially to enable the boys and girls of this crowded neighbourhood to read, as they run, the history of their surroundings.

PRACTICAL ELEMENTARY SCIENCE.

AN EXPERIMENTAL COURSE COVERING THE REQUIREMENTS OF BOTH THE DAY AND EVENING SCHOOL CODES IN PHYSICS AND CHEMISTRY.*

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PART II.

The two Syllabuses.—In this second and concluding part of our course we purpose dealing with Stages II. and III. of the Day School Syllabus, as set out in Schedule IV., Specific Subject XIII., of the Day School Code, and with Part II. of the Evening Continuation School Syllabus, as expressed in Detailed Scheme IV. of the Evening School Code. The two Schemes are printed below in parallel columns.

Day School Syllabus in Physics and Chemistry.	*Evening School Syllabus in Physics and Chemistry.*
STAGE II.	PART II.
Evaporation and Distillation.—Heat absorbed in fusion of ice and in conversion of water into steam; density of ice; change in density of water on heating; moisture in air; wet and dry bulb thermometer. *Air.*—Study of iron rusting and of combustion of candle gas, oil, phosphorus; effect on metals of heating in air; discovery of active constituent of air.	1. **Air and its Constituents.**—(*a*) Investigation into the increase in weight of certain substances when heated; (*b*) the change iron undergoes in rusting; (*c*) the action of burning substances on air confined over water; (*d*) the action of the inactive part of air on heated iron and copper; (*e*) search after the inactive part, and attempt to isolate it; (*f*) the study of the products obtained by burning substances in the active constituent; comparison with those obtained by burning in air.
STAGE III.	2. **Water and its Composition.**—(*a*) Action of vitriol and muriatic acid on zinc; (*b*) burning of inflammable air; (*c*) products of this burning; (*d*) action of hydrogen on red lead and copper oxide; (*e*) action of steam on red-hot iron filings.
Chalk and Lime.—The burning of chalk or limestone; action of muriatic acid on chalk or limestone; carbonic acid; reformation of chalk. Discovery of carbonic acid in air; its formation by combustion of carbonaceous materials and in respiration. Study of action of muriatic and vitriolic acids on zinc; combustion of the gas obtained, and discovery of the composition of water. Presence of air and solids dissolved in water; sea-water; hardness of water.	3. **Chalk, Lime, and Mortar.**—(*a*) Appearance of chalk; (*b*) the limekiln; (*c*) action of heat on chalk, marble, and limestone; (*d*) action of acids on chalk, marble, etc. 4. **Limewater and Carbon Dioxide.** 5. **Mortar.**

Change of State.—In the earlier lessons of this course it was shown that matter can exist in the solid, the liquid, and the gaseous condition, and that the change from solid to liquid and from liquid to gas can, in the case of many common substances, such as water, butter, wax, be readily brought about. It is now time to draw attention to the temperature of bodies, as shown by the thermometer, whilst they are undergoing these changes of state. As water is the best body for readily demonstrating that the same substance can exist in the three states, so also it is the best body to experiment upon in order to make clear what the temperature of the changing body is. The simplest mode of procedure is as follows:—A test-tube containing ice, in which a thermometer is placed, is slowly heated until the whole of the ice has been converted into water, the height of the mer-

* Books referred to in this series of articles are published by T. Nelson and Sons.

cury in the thermometer being carefully noted during the whole of this time. The puzzle is to explain why the thermometer does not rise during the operation whilst more and more heat is taken in. Without waiting to explain the process at this juncture, the heating of the water is proceeded with, and the temperature changes are recorded until the water boils, boiling point being very carefully noted and recorded. The conversion of water into steam now commences, and the thermometer is again most carefully observed whilst the whole of the water is thus being converted into water gas. The experiment should be performed by each group of scholars until the *facts* are well observed by all, so that there may be no doubt in any mind as to what really does happen; after which should come the explanation, which should be somewhat as follows:—The change of state, like all changes, can only be accomplished by work, and work requires energy to perform it. The steam-engine is an ever-present witness to the fact that heat is a form of energy; hence the class may fairly be expected to see that the work of changing solid ice into liquid and gaseous water is done by the energy of heat, which, whilst doing this work, cannot be also engaged in raising the temperature. After the work of liquefaction has been performed, further increments of heat simply raise the temperature until boiling point is reached, when the heat energy again commences the work of changing the state, and ceases from producing the heating effect which alone can be recorded by the thermometer. The pupil may, at the teacher's discretion, be told that the work done in changing the state of the water consists in driving the molecules farther apart, and in giving them an increased rate of motion; but the subject is a difficult one for young minds to adequately grasp, and perhaps it will be as well to rest satisfied with impressing upon the pupils the fact that heat can perform the double function of changing the state of a body and of raising its temperature, but that it cannot do both these things at the same time, so that the heat which is engaged in changing a solid into a liquid, or a liquid into a solid, cannot at the same time raise the temperature, hence it is hidden, or **latent**, so far as the thermometer is concerned. How, then, may we measure this **latent heat of liquefaction** and of **vaporisation?** The next experiment will answer this question. A beaker is weighed, and is then filled about halfway up with water at a temperature of about 30° C. The beaker is again weighed, the increase in weight being the weight of the water that has been poured in, and upon which we are about to experiment, the temperature of which is now ascertained. Some pieces of ice, about as big as a walnut, are carefully dried with blotting-paper, and are then added to the warm water, which is again weighed, the further increase in weight giving the weight of the ice that is to be melted. Whilst the melting is proceeding the ice is stirred about with the thermometer, and the fall in temperature, caused by the heat that has been taken from the water to melt the ice, is very carefully noted and recorded, when the calculation of the latent heat of liquefaction of ice may be proceeded with. The following example will explain how this is done:—Suppose the beaker contained 80 grams of water at 30° C., and that 10 grams of ice were melted, the resulting temperature after the fusion of the ice being 18·4; then, as the heat lost by the water in cooling from 30 to 18·4—that is, 11·6°—is equal to that gained by the ice, we have $80 \times 11{\cdot}6 = 928$ calories of heat given to the ice by the water, of which $10 \times 18{\cdot}4 = 184$ calories were concerned in raising the water (10 grams) obtained from the fusion of the ice from 0° to 18·4°; so that $928 - 184 = 744$ calories of heat were needed to melt 10 grams of ice—that is, 74·4 calories were used in melting 1 gram of ice; in other words, according to this experiment, the latent heat of fusion of ice is 74·4. It should be pointed out that this determination is a very rough and inaccurate one, being much too low in consequence of our neglect of the fact that the beaker was originally at the same temperature as the ice—namely, at 30°—and that in cooling down to 18·4° it also gave out some heat which helped to melt the ice, so that the figures are too low. There are other errors, such as the escape of heat by radiation; but all this may be ignored, the pupil being told that a careful determination would show that 79 calories of heat are requisite to melt 1 gram of ice—a fact that may readily be credited, seeing that our imperfect experiment gave the approximate result—74·4. Other experiments and calculations should be made until the *modus operandi* is clearly understood, the pupil being required to look at the result from the point of view that the amount of heat necessary to melt a gram of ice is capable of raising 1 gram of water 79°, or 79 grams of water 1°, until he thoroughly realises the large amount of heat that is concerned in the internal work of changing the state of ice to that of water.

Latent Heat of Vaporisation.—The first thing to grasp here is that the same quantity of heat that is needed to convert a gram of water into a gram of steam will be given out by a gram of steam in becoming water again, and as it is more convenient to measure the latter than the former, our experiment will consist in ascertaining the amount of heat given out by a known amount of steam upon liquefying. All that is needed, then, is to liquefy a known weight of steam, and to find out how much heat is given out during the process. The method of working is very simple. A beaker is weighed, just as in the previous experiment. A quantity of water is poured into the beaker, and a second weighing is made, whereby the weight of the water upon which we are to experiment is ascertained. The temperature of this water is accurately obtained by means of the thermometer, and steam from a flask of boiling water is passed into the water for some time, after which the temperature is again accurately taken. The beaker is now subjected to a third weighing, whereby the weight of the steam that has been liquefied is found, when we have all the facts needed to calculate the latent heat of liquefaction of steam. In an experiment the weight of water was 121 grams at a temperature of 4° C. After the passing in of the steam the weight of the water was 125 grams, showing that 4 grams of steam had condensed. The temperature of the water was 24° C., so that 121 grams of water had been raised through 20° C., representing a gain of $20 \times 121 = 2{,}420$ calories of heat. To this the water obtained from the liquefied steam—namely, 4 grams—had contributed $4 \times 76 = 304$ calories, because it had cooled down from 100° (the boiling point of water) to 24° C., leaving $2{,}420 - 304 = 2{,}116$ calories as the quantity of heat due to the liquefaction of 4 grams of steam, or 529 calories for 1 gram of steam, a result which is necessarily inaccurate, since we have again neglected the heat-absorbing power of the beaker, and thus the loss on account of radiation. The student will readily believe, from his rough experiment, which should be performed by each group, or, better still, by each individual, that the exact figures are 536; that is, it requires as much heat to convert a gram of water at 100° C. into a gram of steam at the same temperature as would be able to raise 1 gram of water through 536 degrees, or 536 grams of water through 1 degree.

The Apparatus.—The simple apparatus to be used in this experiment consists of a flask provided with a well-fitting cork, carrying a piece of glass tubing bent at right angles, and passing into the beaker containing the water to be heated. There is, however, one special precaution which must not on any account be neglected. The limb of the bent tubing that passes into the beaker must be in two parts, between which must be fitted, by means of two corks, a piece of wider tubing—say of one inch diameter—the two ends of the divided limb being so arranged as not to be in the same straight line. This is done so that any water, formed by the condensation of the steam in the bent tube, may not fall into the beaker, but be caught in the wider tube (see Castle's *Practical Physics*, p. 173). The student should be expected to explain why the passage of this water into the beaker would vitiate the result. In weighing it, we should, of course, take it as so much steam, although its heating power is immensely inferior to that of the same weight of steam, as it has already given up its latent heat of vaporisation; hence the result would be very much lower than should be the case.

Heat required to convert 1 Gram of Ice into 1 Gram of Steam.—This the pupil should now be easily able to calculate. He knows that 79 calories will be requisite to change the ice into water at 0° C. He knows also that to take 1 gram of water from 0° C. to 100° C. requires 100 calories of

heat, and that we need 536 calories to convert 1 gram of water at 100° C. into 1 gram of steam at the same temperature, so that no less than 715 calories of heat are needed to gasify merely 1 gram of water.

Beneficence of this great Latent Heat.—As showing the eternal fitness of created things, the teacher will do well to enlarge upon the wisdom shown in the endowment of water and steam with so high a latent heat. For example, ice would be much more quickly formed were it not for the fact that water gives out such a large amount of heat on solidifying. It is equally convenient that ice and snow should slowly thaw, as they must do in consequence of the great amount of heat that must become latent in thawing them, otherwise disastrous floods would result from the sudden liquefaction of snow and ice. Again, it is good that water should have a high latent heat of vaporisation, since this prevents evaporation from proceeding too rapidly, whereby the earth, in hot climates especially, would be deprived of the much-needed water; and since water-vapour must give up a very large amount of heat before it can become liquid, the devastating falls of volumes of water are guarded against by this high latent heat of vaporisation in the case of water.

Density of Ice.—That ice is lighter than water is readily shown by floating portions of ice on water. The pupils should be questioned as to the full meaning of this, especially with respect to what happens when water freezes. We have already shown that the usual effect of cooling is to produce *contraction*, but here we have *expansion*—a very unexpected result, occurring only in the case of water and a few other substances. A striking experiment in illustration of this same truth may very readily be performed. A test-tube is heated all round a short distance from the top, until it is soft enough to be drawn out into a very thin neck, when the upper portion is cut off by means of a file, leaving a bulb tube with a neck that may very easily be closed by heating it. The bulb is warmed, and, whilst warm, the open end is placed in water. The children should be asked to explain why it is that the water enters the tube as it cools. They may also be asked to suggest a means of entirely filling the tube with water. It should occur to some at least of them that, by boiling the water that has entered, the whole of the air may be ejected, and that, upon the cooling down of the water-vapour that has taken the place of the air, water will rush up to take its place, if only the open end of the tube is held under water. Reference may be made to the filling of the thermometer tube, which was done in exactly the same way. The tube should now be sealed by placing the open end in a Bunsen flame. Next the tube and its contained water is to be placed in a freezing mixture of ice and salt, the contained water being thereby frozen, whereupon the tube bursts because of the expansion of the water upon freezing. The children should be able to see that this affords further proof of the fact that ice is lighter than water.

The Density of Water at different Temperatures.—A very convincing proof of the anomalous condition of water as to density is afforded by the use of **Hope's apparatus**, which can be extemporised by the aid of two tin cans, two thermometers, and a little solder. The bottom of a wide tin can is cut out so that it may fit round the middle of a narrower can, about three times as long as the wider one, which is then soldered to the middle of the narrower one, so as to make a kind of circular shelf round the middle of the longer tube. Near the top of the inner can a hole is cut of about ½ inch diameter, a similar perforation being made at the same distance from the bottom. Into these holes are soldered two tin tubes capable of being closed by means of corks carrying thermometers. The inner can is now filled with cold water at about 8° C., whilst the outer can is packed with a freezing mixture of ice and salt. The two thermometers are closely watched. It will be found that the bottom one falls most until a temperature of 4° C. has been reached, when it ceases to fall, whereas the top thermometer, which at first was almost stationary, falls and falls until it registers 0° C., and we have the paradox of warmer water being at the bottom and colder at the top, from which it should be easy to get the class to see that the warmer water is the heavier, and further, that water at 4° C. is at its heaviest—that is, using technical terms, the maximum density of water is 4° C.

Applications of this.—Quite a wealth of reference can be indulged in under this head. In the first place should be mentioned the all-wise phenomenon of the partial freezing only of the waters of lakes, etc., even in the coldest weather. Secondly, the bursting of water-pipes during a frost should be touched upon, the pupils being specially asked why the burst is not apparent until a thaw sets in. It will also be apt to ask why it is that we said a cubic centimetre of water *at 4° C.* weighs a gram, and so on, it being remembered that every application of science to the everyday occurrences of life raises the study immeasurably in the esteem of the learner.

OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

COAL.

THE question of our coal supply is assuming a most disconcerting aspect. The price of this necessary commodity has increased by leaps and bounds, bringing dismay to the average householder, and causing a serious check to many of our industries. Unfortunately, it is no new thing for artificial shortage of commodities of vital importance to be brought about by speculators, who reap a rich reward from the increased prices which follow their deeply-laid plans. Such abnormal conditions, however, rarely last long; but in the case of coal the end of the trouble does not by any means appear to be near at hand.

There is no doubt that the value of coal was known to the ancients; but in our own country, until the spread of civilisation and the increase in population, there was no necessity to look beyond the vast forests for our supply of fuel. In 1239, Newcastle-on-Tyne received its first charter to dig coal; and half a century later the trade had assumed such proportions as to necessitate special laws for its regulation. The yield of coal gradually increased until the invention of the steam-engine gave the trade an immense and startling impetus. The coalfields of the United Kingdom have been exploited almost to their fullest extent; the capital engaged in the industry amounts to many millions of pounds; and it is not too much to say that our success as a manufacturing nation rests chiefly upon a solid foundation of coal.

As far back as the sixties, public attention was called to the possible exhaustion of our coal supplies. A Royal Commission investigated the matter, and as a result of close inquiry Professor Jevons arrived at the conclusion that our native supplies would not last much more than a hundred years if the production maintained its average rapid progressive increase. In later years further statistics somewhat modified these calculations, and the period of probable exhaustion was doubled, and under certain likely conditions even quadrupled. However experts may disagree upon the length of life of our coalfields, it is evident that the end must eventually come, even though we exploit fresh fields, and delve deeper than hitherto.

Our Increasing Yield.—In 1660 our annual coal yield did not exceed 2,000,000 tons, which was doubled a century later; in 1800 the total output was 10,000,000 tons; in 1854 it was increased more than six times; and in 1871 the total had risen to 118,000,000 tons. These figures are illustrative of the enormous and ever-increasing drain on our sources of supply. The increase, however, has not ended there, for in the year 1899 no less than 220,000,000 tons of coal were torn from the vitals of the United Kingdom. What this enormous bulk really represents, the mind is incapable of grasping; yet it is a fact that a coal famine is rampant in the land, coal has passed beyond the means of the poor, the hitherto comfortable householder is viewing his coal bills with ever-increasing alarm, and manufacturers are debating the desirability of closing factories until prices have reached a more satisfactory level.

Our Customers.—Notwithstanding the shortage at home,

in 1899 we exported over 40,000,000 tons to foreign countries and the colonies. France is by far our best customer, and the growth of our trade with that country during the last three years presents some remarkable features, as shown by the following figures :—

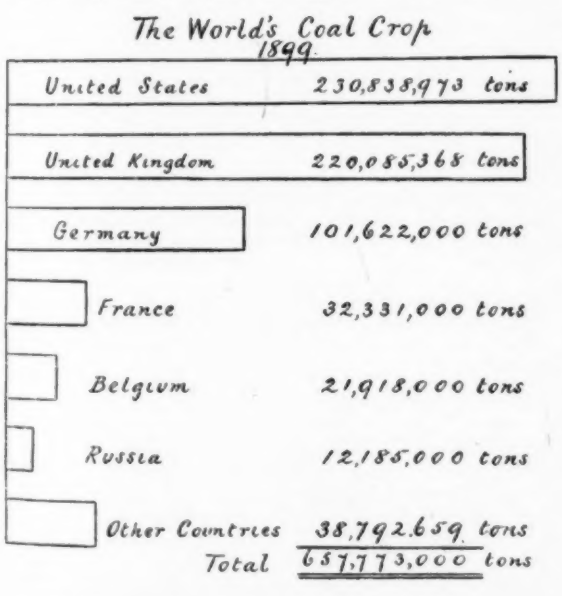
	Tons.	Value.
First six months of 1898.....	2,672,000	£1,166,000
First six months of 1899.....	3,420,000	1,613,000
First six months of 1900.....	4,230,000	3,246,000

The total exported to France in the year 1899 was 6,646,000 tons, which promises to be largely exceeded during the current year.

Italy is another large buyer, since she possesses no coal measures of her own, except a little lignite. To this country we exported five and a quarter million tons.

Germany took five million tons, Russia three and a quarter millions, and Spain one and a half million tons.

A Coal Tax.—The shortage of fuel at home in face of rising exports is causing much irritation, and there are already demands for a duty on all coal exported. It must be remembered that in 1845 an impost of four shillings per ton was removed. Would it, however, be wise to reimpose this duty? It is calculated that such a course would yield a revenue of about £7,000,000, but this amount would probably be lost to us in other directions. A vast and never-ending procession of ships continually arrives on our shores with food stuffs and materials for our manufactures, and coal is practically the only commodity that we can send away in sufficient quantity to provide cargoes for these vessels on



their return voyage. A duty on coal would force ships to go away in ballast. Ballast is expensive, whereas coal pays for its carriage, and yields a profit. Practically a duty upon coal would fall upon our food stuffs and other imported materials, and the nation would but remove the burden from one shoulder to the other.

Reference to our diagram will show at a glance the chief coal-producing countries of the world, and a comparison of their respective outputs.

American Coal.—It will be seen that the United States is already outstripping us in production, though as recently as 1887 the total yield was only 116,000,000. Much American coal is as good if not better than best Welsh, and it is certain that the United States will make a bold bid for a share in the coal trade of the world. It is remarkable that the American collier raises 490 tons per annum, whereas his *confrère* in the United Kingdom raises only 290 tons. The coal measures of America are easier of access than ours, if only from the fact that but little inroad has been made on her resources; but the figures here quoted seem to point out that the American workman is more industrious.

Concentrated action on the part of British coal-owners to artificially inflate prices will certainly cause measures to be taken to defeat them. British naval vessels are already using American coal, and large gas companies are carrying out experiments to test the quality of gas which this coal yields; and it is certain that more general attention will be called to various patent fuels to at least supplement our home supply.

New Coalfields.—The exploitation of coalfields in other parts of the world will receive greater attention than hitherto—for example, it is stated that large fields of excellent coal exist in Morocco, which is only four days' steaming from the south of England.

There are evidences that Australian coal may be largely used for shipping purposes in the Far East. British coal costs sixty-six shillings per ton at Hong-Kong, plus insurance and other charges, whereas Australian coal can be delivered for at least half the price. It is objected that this coal cannot compete with best Welsh in that it is not smokeless; but there is a limit to the price that can be paid for the advantage of freedom from smoke, even in the navy.

The question of our coal supply is a vital one, and affects the wellbeing and prosperity of the nation at large. Whether our native supplies will last a hundred or a thousand years does not enter largely into the matter, since we may rest assured that before this period arrives the provision of new and suitable fuels will have been compassed. Coal has hitherto played an important part in our national prosperity, and we cannot afford to make easy the path for our ever-pressing competitors.

THE INSPECTOR'S NOTEBOOK.

BY AN INSPECTOR OF SCHOOLS.

Let not your Changes be too Revolutionary. With reference to the drawing up of syllabuses, it seems to me that under fairly large School Boards, and in towns generally, teachers would do well to agree upon some of the leading items of the course; otherwise you will find much difficulty with the children who move from one school to another. I do not, of course, advocate that these wanderers should receive undue consideration. We must feel our way gradually, especially with regard to the classification. The abolition of the word "standard" must take place wherever the retention of the term would be misleading. Let it be clearly understood that the inspector will not expect to find something strikingly new every time he visits your school. If a teacher feels he can do better work by adhering generally to the old lines, let him do so. All that will be needed will be for him to demonstrate that the teaching is upon scientific lines. Mechanical methods of all kinds must go.

Things Common and Uncommon. You must all place elementary science upon your time-table. We have for some time dabbled in common (and uncommon) things in the lower standards. Would that we could Americanise this portion of our curriculum! Nature study is a speciality with our cousins. They do this subject thoroughly. Principal Salmon, in his recent pamphlet, says: "In the primary schools the most common centre of interest is nature study. The children are led to observe trees, plants, flowers, animals, and birds, the weather and the ever-changing aspects of earth and sky; they are made to read and write and talk about, to draw and model, what they have seen. In one school the first grade drew a circle for each day, and coloured it according to the weather, the coloured circles forming the basis of the number work."

Nature Study. Much of the instruction in this subject is given out of doors. Thus it is very interesting to the scholar, and very effective. In the towns, the public parks are utilised for this purpose. It is to be hoped we shall develop upon these lines in this country, and then there will be less ignorance respecting the common trees and animals. I know of some few schools where the country walk is already a recognised fact. By adopting this

practice—sanctioned, of course, by the inspector—it will be possible to confine the object-lesson course to things with which the child can be brought into actual contact. At present the thirty lessons are too often a heterogeneous mass of more or less unsuitable subjects. None of us can go far wrong if we bear in mind the suggestive course set forth under Scheme 1 (Board of Education's Specimen Schemes): "A course of lessons dealing with objects familiar to the children, and with matters likely to bear upon the children's lives." How this is meant to apply locally can best be seen by reference to Scheme 5 for a school at a seaside town. We have to train the children to appreciate their environment.

Out-of-door Work for the Children. In the upper standards you proceed to build upon the foundation laid in the lower classes. Please notice the suggestion in Scheme 8 for a large country school: "Visits, where possible, to nursery gardens, creameries, poultry farms," etc. Wherever it is feasible, whether in town or country, a garden should be attached to the school. The scholars can be taught to observe the growth of plants in it. Cottage gardening should be taken to supplement by practical work the theoretical teaching. In France and other Continental countries the school garden is much more common than in this country. This may probably to some extent account for the proverbial agricultural skill of the French peasantry and farmers.

The Children should themselves perform Experiments. With reference to the elementary science of the upper standards in the towns, it will be well to arrange for as much as possible of the work to be of a practical character. Allow the scholars to perform experiments. You may not appear to be progressing very rapidly. In reality your class will, however, be getting on much faster than when the teacher does all the experiments. The curriculum should have some reference to the prevailing industry of the district (compare Schemes 5, 6, and 7).

As to the amount which is to be done in each standard or class, your experience as a teacher will help you to some extent. Where the course is too cramped or too extensive, the matter may be adjusted in conference with the inspector.

Manual Work in all Standards is suggested in Scheme 8. In Scheme 8, "Manual Work" is included in the curriculum, and a course is given for the whole school. This is to some extent a revival of the "Varied Occupations" which were compulsory a few years ago. Training of the hand and eye is destined to occupy a very important position in the curriculum of all schools. There are many educationists now who consider that no educational system is complete without manual work. For many years all infant schools have gone in for hand and eye training. We now find a course in it suggested for the standards. To all teachers I would recommend some continuation of the kindergarten occupations in the lowest standards. Cardboard might follow in Standards IV. and V., and woodwork in the highest classes.

It will be noted that a special grant is obtainable for woodwork and metal-work; but even where the conditions for teaching these do not exist, there is no reason why some other form of manual work should not be taken in the highest classes. I am invariably told, when I inquire about the varied occupations, that that lesson is very popular with the children. That evidence in itself is sufficient to secure a place in the curriculum for manual work. You will find it useful to have this lesson on Friday afternoon or Monday morning, as a stimulant for the irregular children. Crayon-work, clay modelling, and brush drawing are the best for the young children. Brush drawing can be continued right through the school. The girls of the top classes will be able to paint their own Christmas cards.

Inter-relation of Subjects. The course set out in Scheme 8 for the lower standards is "Modelling in clay objects—for example, apple, carrot, plum, acorn, nut—discussed in object lesson." Here and elsewhere in these schemes are to be found references to Herbart's principle of the inter-relation of subjects. In the light of this principle the "overcrowded curriculum" argument wanes. Principal Salmon, in his *brochure* referred to above, illustrates this very aptly: "The various subjects of study were not separated by water-tight compartments; each was brought, as far as possible, into relation with all the rest. The flour, the suet, the currants, and the plums were not presented separately, but mixed into a wholesome and appetising pudding. In one school, for instance, the subject was Scotland. The children were not kept during one lesson to the geography and during another to the history, but both were taken together. The reading was a Waverley novel, the writing a biography of a famous Scot, the drawing a picture of Holyrood, and the modelling a contour of the country."

This correlation of subjects has long been an accepted theory in infant schools. We are quite familiar with the arrangement whereby a class has an object lesson on an apple, then models it in clay, and finally draws and colours it. Again, we have the lesson on the robin, followed by the stencilling and colouring of the drawing, and accompanied by a piece of poetry on the same bird. This principle is not followed out so frequently in the standards.

The Future is in the Hands of Managers and Teachers. When we have smaller classes, we shall be able to more thoroughly apply the principles of psychology in our teaching. Each child ought to receive a certain amount of individual attention from the teacher—the education of the child depends so very much upon its coming into contact with the teacher. The influence of the teacher upon the individual is what we should aim at. Only when the teacher has time and opportunity to make a diagnosis, so to speak, of each child's mind will he approach to that success which should be his ideal. We are gradually arriving at conditions which favour this individual treatment. The new Code makes every allowance for such developments. The managers and teachers have now the opportunity of making improvements upon these lines.

Recitation. No definite number of lines is given under the head of recitation. Let us hope, at all events, that the twenty lines minimum of the old Code will not be so rigidly adhered to as heretofore. I commend to the consideration of my readers the advisability of giving the children plenty of good poetry to learn by heart. There will be less strain upon the memory in all the subjects in future. There should, however, be some exercise for the memory, and learning poetry by heart will serve this purpose admirably.

Answers to Correspondents.

G.B.—You are legally bound to pay.

E.S.—I am pleased to hear from you again. I am sorry I am unable to reply to you in full by post, but hope this answer will be of service:—

1. Separate registers must be kept—
   (*a*) For children under three.
   (*b*) For those between three and seven.
   (*c*) For those over seven.
2. Divide your school into two main groups—
   (*a*) Infants: Standards I., II. (or Standards I., II., III.)
   (*b*) Standards III. to VII. (or Standards IV. to VII.).
   Then subdivide again a little; for example—
   (*a*) Infants: Standard I.
   (*b*) Standards II., III.
   (*c*) The rest.
3. Write to the Secretary, Board of Education, Whitehall, S.W., for specimen schemes. They are provided free. Study Scheme I. therein set forth. That scheme itself answers several of your questions.
4. For history get a different reading book this year—a more general one—and draw up twenty lessons picked from the whole range, from the Conquest.
5. For geography take the *outlines* of Europe. Write again for further help whenever you need it. You must have one of the most difficult of schools.

Correspondence should be addressed—Inspector, care of the Editor. For replies by post, a stamped addressed envelope must be enclosed.

☞ *See Page 3 of Wrapper for announcement of Mr. Edser's*

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OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Principal of the Belvedere Pupil Teachers' Centre, First on Scholarship List, Author of "Scholarship School Management," "Building of the British Empire," etc.

SPRING EXAMINATION, 1901.

Sixth Month—October.

WORK TO BE PREPARED.

1. READING AND RECITATION.

CONTINUED oral practice, with due attention to emphasis, modulation, clear enunciation and articulation.

2. ENGLISH.

Candidates.—*Marmion*, Canto vi., lines 569–680.
First Year.—*The Traveller*, lines 239–296, with twenty roots and meanings each week, and the derivation of all important words in the passage set for preparation. Knowledge of all allusions, etc.
Second Year.—*Julius Cæsar*, Act iii., Scene 2, with all meanings, allusions, etc.

3. ESSAYS.

Write one or two essays each week, selecting from the following:—*Holidays; The Penny Post; Cheerfulness; Paper-making; "Knowledge is Power;" Fairy Tales; Fishing.*

4. HISTORY.

Candidates.—The Tudors, 1485–1603.
First Year.—The Lancastrian kings, Henry IV. to Henry VI.
Second Year.—William and Mary. Anne.

5. GEOGRAPHY.

Candidates.—The counties of Wales in detail.
First Year.—Asia: physical features, climate, productions, and races of people.
Second Year.—British North America.

6. ARITHMETIC.

Candidates.—Recurring Decimals.
First Year.—Compound Interest.
Second Year.—Continued practice in Stocks and Shares.

7. EUCLID AND ALGEBRA.

First Year.—Props. 17–20, with four deductions per week. Continued practice in factors.
Second Year.—Revise definitions, axioms, and postulates, and Props. 1–6, with eight deductions per week. Simple equations, and problems thereon.

8. MUSIC.

General revision and working of back questions. (See list given last month.)

Notes on the Month's Work.

1. ENGLISH.

For full notes on parsing, paraphrasing, etc., see October Number, 1899.

2. HISTORY.

Candidates.—The Tudor period is one of great importance. It was an era of new movement, new statesmanship, new thought, and new development, and hence is deserving of especial study.

Note the *causes of high prerogative exercised by the Tudors:*—
1. The decay of the great baronial houses, which could no longer put a check upon the king.
2. The new aristocracy chosen from among the king's friends, and hence subservient to him.
3. The power of the Commons not yet sufficiently strong to oppose the king.
4. The general desire for peace.
5. The personal character of the Tudors themselves.

Henry the Seventh amassed money by many means, of which note should be made. The marriages of his children are important, as they led to serious results in after history. The marriage of Catherine of Aragon with Prince Arthur, and, on his death, with Prince Henry, indirectly led to the Reformation. The marriage of Margaret with James the Fourth of Scotland brought the Stuarts to the throne of England.

Henry the Seventh. The rule of Wolsey and the Reformation are the most important points. Note that Henry denied the supremacy of the Pope merely to obtain his divorce. He was hostile to the Reformation. The dissolution of the monasteries, by taking away those who relieved the poor, entailed the consideration of a new means of providing for them. This resulted in the Poor Laws of Elizabeth.

Edward the Sixth and Mary. These reigns were mainly occupied with religious matters. The former was favourable to the Reformation; the latter is noted for the vigorous persecution of the Protestants.

Elizabeth. This is a reign of the greatest importance, when England developed most rapidly as a mercantile, maritime, and powerful nation. The voyages of the Sea Dogs, the introduction of the weaving industry, the gradual settlement of the religious differences, the long contest with Spain culminating in the defeat of the Armada, the great outburst of literature, are all deserving of close study.

First Year.—The Lancastrian kings. Chief points:—The plots against Henry the Fourth; the increase in the power of the Commons, since the king was indebted to them for his position; the Lollards and the Statute De Hæretico Comburendo; Henry the Fifth's campaign in France; Henry the Sixth's minority; jealousies of the nobles, and consequent loss of French possessions; Joan of Arc; the Wars of the Roses—(*a*) causes, (*b*) events, (*c*) results. A comprehensive genealogical table must be prepared. Edward the Fourth—the indolent, licentious monarch; the bold, clever general. Richard the Third's usurpation and dethronement.

Second Year.—The reign of William and Mary commences a new epoch in history—the rule by parliament. The formation of a strictly limited monarchy. Note that the Declaration (subsequently Bill) of Rights settled once and for all the points which had been in dispute between king and parliament for centuries, and effectually precluded such misrule as had occurred under the Stuarts. Every detail of the reign is important:—The reduction of Ireland and Scotland; the Toleration Act (long needed and much appreciated); the Mutiny Bill (originating a legal standing army); the commencement of the National Debt; the government by party (Whig or Tory) and Cabinet; the Triennial Bill, etc. The spirited foreign policy, directed to curbing, and if possible breaking, the enormous power of Louis the Fourteenth of France, was continued in Anne's reign by the War of the Spanish Succession. The Legislative Union with Scotland and the trial of Dr. Sacheverell deserve notice—the latter from its political bearing.

3. GEOGRAPHY.

In all years the same process of preparation must be followed. Draw plenty of sketch-maps, and insert only what is to be remembered, and practise till known.

Second Year.—Pay special attention to the productions, imports, and exports. Much valuable and up-to-date information may be obtained from the little books issued gratuitously by the Agent-General for Canada and the Canadian Pacific Railway Company. Note the term "Dominion of Canada," and what it means. Prepare a list of the provinces, territories, and chief

towns, and notice the method of government. The standing difficulty with the French over the fishing on the banks of Newfoundland requires a few words. When Newfoundland was ceded to England, a clause in the treaty reserved to the French the islands of St. Pierre and Miquelon, and the right to use the coast for drying their fish—that is, cod. The evident intention was to afford them an opportunity, equal to that of the settlers, of preserving the harvest of the sea. Since then the French have attempted to make the meaning of the treaty to be that they have the exclusive use of the coasts, not only for drying or salting cod, but for fishing, mining, canning lobsters, etc. This has led to much dispute and ill-feeling between the two nations, and the difficulty is not settled yet.

4. Arithmetic.

Candidates.—The rule for converting recurring decimals into vulgar fractions must be clearly understood, and also the method of adding and subtracting recurring decimals without reducing them to equivalent fractions. Especial notice should be given to *sevenths* and *thirteenths* expressed as decimals; for example, $\frac{1}{7} = \cdot\dot{1}4285\dot{7}$, $\frac{2}{7} = \cdot\dot{2}857\dot{1}\dot{4}$, etc.—the same six figures occurring for each, but commencing with a different digit. All text-books point this out, but comparatively few pupil teachers seem to understand it. Questions such as the following continually occur in examination papers: "Reduce to a vulgar fraction $\cdot 38\dot{5}7\dot{1}4\dot{2}$." To reduce this in the ordinary way is a long and tedious process, but utilising the information about sevenths the decimal becomes—

$$\cdot 3\dot{4}, \text{ which equals } \frac{3\frac{4}{7}}{10} = \frac{27}{70}.$$

First Year.—In working compound interest, adopt the fractional method. For example: 5 per cent. = $\frac{1}{20}$ of principal, 4 per cent. = $\frac{1}{25}$, 3 per cent. = $\frac{1}{33\frac{1}{3}}$, etc.

The following is a model solution:—

Find the compound interest on £4000 for 3 years at 5 per cent.

Principal	=	£4000	0	0
First year's interest = $\frac{1}{20}$ of £4000	=	200	0	0
Second year's principal	=	£4200	0	0
Second year's interest = $\frac{1}{20}$ of £4200	=	210	0	0
Third year's principal	=	£4410	0	0
Third year's interest = $\frac{1}{20}$ of £4410	=	220	10	0
Total at end of third year	=	£4630	10	0
Therefore interest	=	£630	10	0

It is also better to work in decimals of a pound than to work out shillings and pence, except in very simple cases as above.

5. Euclid.

All students should practise writing out propositions and deductions against time, using other letters than those used in the text-book.

Test Questions.

1. *Penmanship.*
   Large Hand:—*Superfluity.*
   Small Hand:—*A land of tyrants and a den of slaves.*
   (Use the *Practical Teacher Copy Book* regularly.)
2. *English.—Candidates.*
   (*a*) Analyse:—"'I thought *to slay* him *where* he stood.
   'Tis pity of him too,' he cried.
   'Bold *can* he speak and fairly ride;
   I warrant *him a soldier* tried.'"
   (*b*) Parse the words in italics.

   First Year.
   (*a*) Paraphrase lines 227-238.
   (*b*) Analyse:—"Some sterner virtues.....
   .....in a kinder sky."
   (*c*) Parse:—"Like their pleasures," "such as play," "to sport."

   Second Year.
   (*a*) Paraphrase:—"I could well be moved.....
   .....to keep him so."
   (*b*) Analyse:—"Yet, in the number.....
   .....to keep him so."
   (*c*) Parse:—"And that I am he, let me a little show it even in this."
3. *History.—Candidates.*
   (*a*) What do you know of the Lollards? In what did they differ from the orthodox churchmen of the day?
   (*b*) Draw a genealogical table showing the descent of the Lancastrian, Yorkist, and Beaufort families.

   First Year.
   (*a*) Give some account of the declining years of Edward the Third's life.
   (*b*) What causes led to the Peasants' Revolt, and what were the chief results?

   Second Year.
   (*a*) What do you know of Monmouth's Rebellion and its results? Why did it fail, where William of Orange succeeded?
   (*b*) What was the Declaration of Indulgence? Why was there such opposition to it from some of the people whom it would have relieved?
4. *Geography.—Candidates.*
   (*a*) Give a full account of Devonshire, and illustrate your answer by a sketch-map.
   (*b*) What do you know of the following:—Fowey, Cheddar, Trowbridge, Exeter, Ventnor, Harrogate, Redditch, Coventry?

   First Year.
   (*a*) Give, in the form of a table, the countries south of the Danube—their (1) population, (2) chief imports and exports, (3) chief towns, (4) governments.
   (*b*) Describe a coasting voyage from Venice to Odessa.

   Second Year.
   (*a*) Say what you can of the animal productions of British North America.
   (*b*). Give some account of the river and lake system of Canada.

AUTUMN EXAMINATION, 1900.

The following are additional questions for revision purposes, all taken from recent examination papers:—

Deductions in Euclid.

1. A line AD is drawn perpendicular to the base of a triangle ABC. Show that the line AB is greater than either of the lines AD, BD.
2. O is any point on the line joining the vertex A of a triangle ABC to the middle point of the base. Prove that the triangles OAB and OAC are equal in area.
3. If the square described on one side XY of a triangle XYZ is equal to the sum of the squares described on the other two sides, the angle XZY is a right angle.
4. If from the angles of a parallelogram taken in order equal distances in the same direction are cut off from the sides, and the points of section joined, prove that the figure so formed is also a parallelogram.
5. ABC is a right-angled triangle having the right angle at B. On AB and BC are described squares ABDE, BCFG outside the triangle. Prove that the points EBF are in a straight line.
6. Show that the triangle formed by joining the middle points of the three sides of an isosceles triangle is itself isosceles.
7. If from the angles of a rhombus taken in order equal distances in the same direction are cut off from the sides, and the points of section joined, prove that the figure so formed is not a rhombus.

   From the sides of the rhombus ABCD, AE is cut off = BF = CG = DH. Show that the figure EFGH is not a rhombus.
8. If two adjacent sides of a quadrilateral are equal, and the angle contained by them is bisected by a diagonal, show that the other two sides are also equal, and that the angle contained by them is bisected by the same diagonal.
9. Construct an isosceles triangle, having the vertical angle four times either of the angles at the base.
10. From the ends A and B of a straight line there are drawn at right angles to AB, but in opposite directions, two equal straight lines AC and BD, and the points C and D are joined by a straight line cutting AB in E. Prove that each of the lines AB, CD is bisected at E.
11. If a rhombus and a square are described on the same straight line, the area of the square is greater than that of the rhombus.
12. Two equal lines POQ, SOT intersect in a point O such that PO, SO are equal. If TP, QS produced meet in K, prove that KPS is an isosceles triangle.
13. APB, CQD are opposite sides of a parallelogram ABCD. Prove that the sum of the areas ACP, PDB, CAQ, QBD is equal to the area of the parallelogram.
14. ABC, DEF are two triangles. The angles B and E are equal; so are the angles C, F; so are the sides AB, DF. Are we justified in inferring that these triangles are equal in every respect?
15. Given the extremities of a shorter side of a right-angled triangle and the sum of the other two sides; construct the triangle.
16. AB is the side of a square, C is a point in the opposite side. Prove that the triangle ABC cannot be equilateral, but may be isosceles.
17. PR, PY are two straight lines; through any point S draw a straight line meeting them in T, W respectively, so that PT may be equal to PW.
18. In the hypotenuse PR of a right-angled triangle PQR a point S is taken, so that PS is equal to PQ, and QT is drawn at right angles to PR. Show that QS bisects the angle TQR.
19. Find the centre of a circle that shall pass through two given points and have a given diameter.
20. Trisect a given right angle.

Elementary Science.—Candidates.

1. You are provided with a glass tube in the shape of the letter U. The tube is open at both ends. How, by the use of this tube, can you roughly determine the specific gravity of a liquid which does not mix with water? Take the case of oil.
2. Each side of a cardboard square is 12 inches long. The square is hung up by a thread fastened to one of its edges at a point 3 inches from a corner. Draw a diagram to show the position in which the square will hang.
3. A plank is 24 feet long, and its weight is 144 lbs.; 15 feet of its length project over the edge of a quay. It is prevented from tipping over by a weight placed on the shore end. What is the smallest weight that will answer the purpose? Ans. 36.

4. Explain what you mean by the mechanical advantage of a machine. What mechanical advantage is obtained in raising a weight by drawing it up a smooth plane 12 feet long, whose upper end is 6 feet above the lower end?

5. When a stone is whirled in a circle by a tight string, what force keeps the stone in its circular path? If the circle described by the stone is vertical, when is the force greatest? Give reasons for your answer.

6. You are provided with a lump of stone and a spring balance. How can you determine (1) the volume of the stone, and (2) its specific gravity? State any principle that you assume in your work.

7. What do you mean by the centre of gravity of a body? One leg of a square table is cut off: will the table stand on the remaining legs? Give reasons for your answer.

8. What is the use of a fixed pulley? What is the effect of friction (1) when a fixed pulley is used to raise a weight, (2) when it is used to support a weight?

9. A sloping plank reaches from the floor to the ceiling. A heavy ball rests on the plank, and it is prevented from rolling down by a thread which is fastened to a nail in the ceiling. Draw a diagram to show the forces acting on the ball. What position should be chosen for the nail so as to make the tension of the thread (*a*) as great as possible, (*b*) as small as possible?

10. A locomotive is running on a circular railway. What is the force that constrains it to move in a circle (that is, the "centripetal" force)? On which side of the line is it most likely to leave the rails? Give reasons for your answer.

11. What is the weight of a cubic centimetre of water? Explain how you would find the specific gravity of a solution of salt and water. (Describe *one* method only.)

12. You wish to find the weight of a flat graduated ruler. You have a weight of 10 grams, but no balance. Explain how you would proceed.

13. An iron rod is bent at right angles, the two arms being equal. Where is the centre of gravity? How would you find this point experimentally?

14. By means of ropes, three men, all equally strong, are pulling down a post. Two of the men pull due north. Draw a diagram to show the forces which act on the post, and the direction in which it may be expected to fall (1) when the third man pulls north-east, (2) when he pulls due east.

15. A screw with 3½ threads to the centimetre works through a fixed collar, and is turned by a power arm 30 centimetres long. Through what distance will the end of the power arm travel whilst the screw moves 12 centimetres forward? (Take the circumference of a circle as $\frac{22}{7}$ of the diameter.)

First Year.

1. Snow and salt are mixed together, and a thermometer is plunged into the mixture. Describe the results that may be observed.

2. How could you prove to a class that metals expand when heated?

3. A mixture of ice and water is heated until the whole begins to boil. Trace the changes in volume that the mixture will experience. If you wish to observe these changes, how would you arrange your experiment?

4. A room is lighted only by one long narrow window. A person sitting opposite the window holds a pencil near the wall. He observes that the shadow which the pencil throws on the wall varies in character as well as in position, according as the pencil is held parallel to the length or to the breadth of the window. Describe the variation, and account for it.

5. You look down upon a brick at the bottom of a tub of water, your eye being above the middle of the brick. Will the brick seem larger or smaller than if there were no water in the tub? Draw a diagram to illustrate your answer.

6. What is the reading of a Centigrade thermometer when placed (1) in water which is just beginning to freeze, and (2) in water which is just beginning to boil?

What is the reading of a Fahrenheit thermometer in each situation?

What alterations in these readings would you expect, supposing that salt was dissolved in the water?

7. A piece of ice is carried by a little iron boat which floats in a basin of warmish water. Sawdust is sprinkled over the surface of the water. Describe and explain the movements that may be observed in the sawdust.

What results would have been obtained if the ice had been fastened to the bottom of the basin?

8. You wish to find whether more heat is required to raise one gram of water or one gram of turpentine through 1° Centigrade. Explain how you would proceed. What result would you expect to get?

9. A person (1) lays a penny at the bottom of a glass vessel, (2) pours water into the vessel, (3) holds the vessel so that he can see the reflection of the penny on the surface of the water. Draw a diagram to show the passage of a ray of light from the penny to his eye. Of what colour will the surface of the water appear?

10. Name in order the colours into which sunlight can be broken up. How, without the use of any elaborate contrivance, can these colours be obtained from sunlight? In what natural object may they be observed?

11. What temperature will a thermometer register if placed at the bottom of a frozen pond? How do you explain the result?

12. How would you ascertain the melting point of a small piece of wax from a wax candle?

13. When quantities of heat are measured, what is taken as the unit or standard of measurement?

You wish to estimate roughly the quantity of heat given off by 50 grams of iron wire in cooling down from 50° Centigrade to 0° Centigrade. How would you proceed?

14. A straight line is drawn on a piece of paper. One part of this line is viewed with the naked eye, and one part through a piece of window glass. Draw a diagram to show why, in certain positions of the glass, the two parts will not appear in the same straight line.

15. What are the three things that may happen to rays of light when they fall upon a body? What happens to sunlight when it falls upon a red glass window?

Second Year.

1. How can you obtain a compound of oxygen and iron? How one of oxygen and carbon? How one of oxygen and hydrogen? In each case name the body obtained.

2. Explain how it is that lime is sometimes used to soften water.

3. Describe the shape of the crystals which pure silica forms. Give their ordinary name. Name substances that contain a large amount of silica.

4. A compass and a bar-magnet are placed upon a table. A pole of the magnet is brought near to the compass on the north-east side. The compass needle now points to the north-west. An unmagnetised iron bar of about the same length as the magnet is placed alongside the latter. The compass needle now points nearly to the north. Explain these facts.

5. A person travelling from London to California from time to time looks at the compass. What variations of the needle from the true north will he find in the course of his journey?

6. Of what is the bright part of a candle flame composed? In what other forms is the same substance formed in a pure or tolerably pure state?

7. A piece of phosphorus is burnt over water under a bell-jar whose rim dips into water. What changes take place (1) in the air, and (2) in the phosphorus?

8. How can we obtain (1) lime, (2) slaked lime, (3) lime-water? What is the result of letting a stream of carbon dioxide gas pass into lime-water?

9. A bar-magnet is dipped into iron filings and then withdrawn. Describe and account for the results that will be obtained.

10. A steel bar is (1) weighed, (2) magnetised, (3) weighed again. What does this experiment tell us about the nature of the magnetic force of the earth? Mention some other fact or experiment that gives similar information as to the nature of this force.

11. Name the solid and the gas which are obtained when chalk is burnt in a limekiln. Describe some other method of obtaining this gas from chalk or marble. Mention its chief properties.

12. One of three vessels contains pure water, another a weak solution of salt and water, and the third a strong solution of salt and water. How, without tasting, can you tell which is which?

13. Describe a Bunsen gas-burner. How does its flame differ from that of an ordinary gas-burner? Account for the difference.

14. Two darning needles of equal length are magnetised so that the eye of each is the north-seeking end. Each needle is stuck by the point into a cork so that it will float upright with the eye upwards, and the corks are placed side by side in water.

What magnetic forces will act between the poles of the needles? Explain why some of these forces will be greater than others. What will be the net result of them all?

15. A strong bar-magnet, 20 centimetres long, is laid upon a table in an east-and-west position, with its north-seeking end towards the east. A small compass is laid upon the table in three different successive positions, each at a distance of about 12 centimetres from the centre of the bar. The first time the compass is due east of the centre, the second time north-east, and the third time due north. Draw a diagram to show in each case how the compass needle will settle itself. Make clear which, in each case, is the north-seeking end of the needle.

THE EXAMINATION.

Much advice has been given from time to time in these columns as to the best method of setting about an examination, and "generalship" in dealing with the questions is of more importance than ever, since the time allowed is less than it used to be. The times allotted at the last examination were:—Arithmetic, 1 hour (three questions); History, ¾ hour (three questions); Geography, ¾ hour (three questions); Elementary Science, ½ hour (three questions); English, 1¼ hours (three questions, and an exercise in Composition); Euclid, ¾ hour (two questions); Algebra, ¾ hour (three questions); Needlework, 1 hour; Music, ¼ hour (three questions).

From this it is apparent that there is no time to be lost in thinking over questions. In fact, it is a matter of great difficulty for any well-read student to get through the work in the time. Still, since the attempt has to be made, students are advised earnestly to limit the period for each subject to the time proposed—that is, longer time must not be devoted to one subject to the detriment of others. The answers must be clear, concise, and condensed as far as possible. All introductions and generalities are to be avoided; put down facts only. Tabulate the answers wherever they admit of this treatment, and in geography use sketch-maps for giving information. The arithmetic in recent examinations has been decidedly difficult, and that paper will require the closest attention. There is comparatively little actual calculation in the problems, but many pupil teachers attempt to work them without having found out exactly what is required, and the quickest way of working. For instance, in the Candidates' paper we get—

"Simplify $\frac{215{\cdot}4423}{{\cdot}267} - \frac{2154{\cdot}423}{2{\cdot}67}$."

The majority of candidates worked each fraction out separately, when a very little thought would have shown that if the numerator and denominator of the first were multiplied by 10 (this would not alter the value) the fractions become identical, and the answer is 0 at sight. It is a good plan with all problems to prove the result and see if it satisfies the question. This does not take long.

Accuracy, neatness, methodical arrangement, and *facts* are required. All empty verbiage is worse than useless.

Next month we shall commence a new course for the Autumn Examination of 1901. The following are the text-books which are recommended:—

Geography—Brook's *Descriptive Geography* (Nelson); Meiklejohn's *New Geography*; Blackie's *Manual of the British Isles*; *The Globe Hand Atlas* (Nelson); Holden's *New Atlas*. History—*Royal History of England* (Nelson); *Outlines of English History*, by A. B. Buckley (Macmillan and Co.), for Candidates; Meiklejohn's *History*; Will's *Synopsis of English History* (Blackie); Longmans' *Historical Atlas*. Arithmetic—Christian and Collar's (A. M. Holden). English—*Higher-Grade English* (Nelson); Nesfield's *English Grammar* (Macmillan and Co.); *Pupil Teachers' English Notebook* (Nelson); Candidates—*Marmion*, Canto vi. (Nelson); First Year, *The Traveller* (Macmillan and Co.); Second Year, *Julius Cæsar* (Moffatt and Paige). Reading—*The Talis-*

man (Messrs. A. and C. Black); Southey's *Life of Nelson* (Macmillan and Co.); *Frederick the Great* (Macmillan and Co.). Elementary Science—Cartwright's "*Section One*" *Physiography* (Nelson). Music—*Music for Pupil Teachers, etc.* (Nelson); *Stanton's Notes* (J. Curwen and Sons); *Practical Music for Pupil Teachers* (J. Curwen and Sons). Algebra—M'Kean's *Algebra for Students* (Nelson); Hall and Knight's (Macmillan and Co.). Euclid—Hall and Steven's (Macmillan and Co.). Penmanship—*Practical Teacher Copy Book.*

A good etymological dictionary, such as Skeat's, etc., is also an essential.

There are many other excellent books published, but the above will meet all the needs of any pupil teacher.

SCHOLARSHIP EXAMINATION, 1900.

Tenth Month—October.

WORK TO BE PREPARED.

1. *Penmanship.*—A few minutes' daily practice from *Practical Teacher Copy Book.*

2. *Theory of Teaching.*—Chap. xiii., *Scholarship School Management.*

3. *Geography.*
   (1.) Revise Central America.
   (2.) The remaining possessions in America.

4. *History.*—Victoria.

5. *Composition.*—One or two essays each week, on such subjects as:—
   (*a*) The attitude of the Government to the Colonies prior to 1860.
   (*b*) The character of the Anglo-Saxons.
   (*c*) The character of Julius Cæsar as depicted by Shakespeare.
   (*d*) The Canadian Pacific Railway.
   (*e*) The abolition of slavery.
   (*f*) Criticism of some book you have recently read.
   (*g*) "Little strokes fell great oaks."

6. *English.*
   (1.) Analysis and parsing. Revise all terms used; learn derivations and definitions.
   (2.) Twenty roots and meanings per week.
   (3.) Revise the history of the language from 1066 to 1485.
   (4.) *Julius Cæsar*, Act v., Scene 5.

7. *Arithmetic.*—Problems on motion, clocks, etc. (chaps. lvi. and lvii., Christian and Collar), with exercises in any problems, etc.

8. *Algebra.*—General practice.

9. *Euclid.*—Revise the first half of Book I., with six deductions per week.

10. *Elementary Science.*—Apparent movements of the fixed stars and sun. Phases of the moon and the seasons.

11. *Languages.*
   Latin—*Pliny's Letters*, No. 10, with retranslation. Exercises in reading unseens; grammar and composition.
   French—*Le Trésor*, three pages, with retranslation. Exercises in reading unseens; grammar and composition.

12. *Drawing.*—A freehand copy each week, and exercises in geometry.

13. *Music.*—Chap. x., *School Music Teacher.*

14. *Domestic Economy.*—Revise Clothing and Washing. Rules for warming, cleaning, and ventilating the dwelling.

Notes on the Work for the Month.

Geography.—Copy into notebook and learn the following notes:—

Bermuda.—Area, 19 square miles; population, 16,000. Productions—onions, potatoes, melons, pumpkins, arrowroot, lily bulbs, turtle. Strongly fortified. Capital, Hamilton. Government—Governor, Executive Council (nominated), House of Assembly (elected).

The West Indies.—Tropical climate; mean yearly temperature, 78°. Prosperity mainly dependent upon vegetable productions, the chief of which are—sugar, bananas, oranges, coffee, cocoa, cotton, pimento, nutmegs, indigo, tobacco, maize, guava, ginger, cocoa-nuts, aloes, sassafras, castor-oil plant. Fruits—pine-apples, pomegranates, cocoa-nuts, oranges, lemons, limes, citrons, bananas, plantains, yams, manioc. Timber—mahogany, cedar, lignum-vitæ, ironwood. Corn and rice. The prosperity of the British West Indies depended mainly on the sugar trade, which has been crippled (*a*) by the emancipation of slaves, (*b*) by the growth of beet in Europe, and (*c*) by the terrible storms. Money has been granted by the Imperial Parliament to help planters over the depression.

(1.) *Jamaica.*—4,000 square miles. Population, 730,000. Transit, 16 days.
Productions: sugar, rum, coffee, bananas, oranges, drugs, spices, and timber.
Government—Governor, Council and Assembly (partly elected).
Towns: Kingston, Port Royal, Spanish Town, Montego Bay.

(2.) *Bahamas.*—5,700 square miles. Population, 50,000.
Productions: sponges, pine-apples, bananas, cocoa-nuts, tomatoes, etc.
Government—Governor, Legislative Council and elected Assembly.
Chief town: Nassau.

(3.) *Leeward Islands*, consisting of five presidencies:—

1. Antigua—108 square miles. Population, 36,000.
   Products: sugar, rum, molasses, tamarinds, and arrowroot.
   Capital: St. John.
   Barbuda—75 square miles. Population, 580.
   Products: corn, cotton, pepper, tobacco.

2. St. Christopher—68 square miles. Population, 35,000.
   Products: sugar, molasses, and rum.
   Capital: Basseterre.
   Nevis—50 square miles. Population, 13,000.
   Products: sugar, rum, molasses, limes, coffee.
   Capital: Charlestown.
   Anguilla—35 square miles. Population, 4,000.
   Products: salt, phosphate of lime, cattle.

3. Dominica—291 square miles. Population, 27,000.
   Products: cocoa, sugar, coffee, molasses, rum, lime juice, fruit, spices.
   Capital: Roseau.

4. Montserrat—47 square miles. Population, 12,000.
   Products: limes and sugar.
   Capital: Plymouth.

5. Virgin Islands—58 square miles. Population, 5,000.
   Products: sugar, poultry, copper.
   Capital: Roadtown.

(4.) *Windward Islands*:—
Grenada and the Grenadines. 15 square miles. Population, 53,000.
Products: cocoa, spices, sugar, rum, cotton, coffee, and fruit. Timber and turtles.
Capital: St. George.
St. Lucia—233 square miles. Population, 50,000.
Products: sugar, molasses, cocoa.
Chief towns: Castries and Soufrière.
St. Vincent—140 square miles. Population, 41,000.
Products: sugar, molasses, rum, arrowroot, cassava, cocoa, coffee, cotton, and spices.
Capital: Kingstown.
Barbadoes—166 square miles. Population, 190,000. A separate government.
Products: sugar, molasses, rum.
Capital: Bridgetown.

(5.) *Trinidad.*—1,750 square miles. Population, 260,000.
Products: sugar, cocoa, molasses, rum, cocoa-nuts, and pitch.
Chief towns: Port of Spain, Fernando, Princetown, Arima.
Government—Governor, Executive and Legislative Council.

(6.) *Tobago.*—114 square miles. Population, 19,000.
Chief towns: Scarborough and Plymouth.

History.—The reign of Queen Victoria is important in every detail. Especial attention should be given to the wonderful advances made during the reign in everything—for example, gas, electric lighting, matches, railways, telegraph, telephone, submarine cables, steam and its many applications, photography, the use of anæsthetics in surgery, the advance in surgery itself, in sanitation, education, religion, temperance; the vast increase in wealth and revenue. The Repeal of the Corn Laws opened the era of free trade.

Endeavour to read some larger book on the reign than the ordinary text-book.

Arithmetic.—Problems on clocks and watches are of frequent occurrence. The best method of solution is as follows: Take, for example, "At what time between three and four are the hands opposite?"

Draw a diagram of the position, when it will at once be seen that the short hand will be a certain number of minute spaces past three, and the long hand the *same* number of minute spaces past nine. Let N = the number.

Now, reckoning from the last hour (this must always be done), the minute hand has moved through 45 + N minute spaces, the hour hand through N.

The rates of the travelling are as 12 : 1. Therefore we get the proportion—As 12 : 1 :: 45 + N : N.

Multiply extremes and means.

$$12N = 45 + N,$$
$$\text{or} \quad 11N = 45,$$
$$\text{or} \quad N = 4\tfrac{1}{11}.$$

The time therefore is $45 + 4\frac{1}{11}$, or $49\frac{1}{11}$ minutes past three.

A start should also be made this month in carefully revising the theory, learning definitions, and making quite sure of the reasons for all processes employed. Proofs of the various rules should, wherever possible, be learned.

Euclid.—Practice should be taken in writing out propositions against time, as the shortness of time is the greatest difficulty in the examination.

Test Questions.

1. *Penmanship.*
   Large Hand :—*Australian Federation.*
   Small Hand :—*My heart is thirsty for that noble pledge.*
2. Explain fully what are the chief uses of object lessons, and add any general rules you would observe in giving such lessons.
3. Say what you can of the climate, productions, and towns of the Pacific slope (U.S.A.).
4. Give your opinion as to the future prospects of the North-West Territories of Canada.
5. Say what you can of the Catholic Emancipation Bill. What disabilities did it remove from the Catholics?
6. Parse fully the words in italics below :—
   (*a*) Her eyes were red with *weeping*.
   (*b*) He was *running* at full speed.
   (*c*) While *waiting* for the train, I caught cold.
   (*d*) On *turning* round, I ran against him.
   (*e*) Only by *selling* his horse could he get the money he wanted.
7. What new words have been added to the language as a result of (1) the colonisation of North America, (2) our intercourse with India and the East?
8. Draw diagrams to illustrate eclipses. What information do we gain from these events?

CORRESPONDENCE: RULES (as usual).

Answers to Correspondents.

X.Y.Z.—Penmanship, 18/20. The only fault is that the general shape is too round. It would be much better if oval.

Yankee.—Essay, 14/20. Cultivate a quieter style. Penmanship, 13/20. Still very stiff, and lacking in ease.

I prefer writing on one side of the foolscap only. Your query in science can only be properly explained by working it out with a globe, which, I think, you could do for yourself. There is no *method* of resolving the expression into factors. It is one of those things which are taken as facts.

H.L.M.—I should advise you to leave the subject alone. You cannot learn chemistry without seeing experiments worked.

A.T.—The question is meaningless. I have never yet been able to discover what the examiner had in mind in setting it.

N.F.—I should think that you would be able to do so with very little practice. The tests are very easy, and are graduated.

Runnymede.—Penmanship, 15/20. Too heavy and stiff in style. Letters should be looped. Essay, 40/60. Style needs attention; it is forced and unnatural. The first essential is perfect lucidity. Say "different from," not "different to;" "disastrous," not "disasterous." Facts not altogether correct.

E.L.V.—I will try to insert it in next month's course.

A + B.—With the third power of x you get *three* values, thus—

$$x^3 - 1 = 0.$$

Split up the quantity into factors, then

$$(x - 1)(x^2 + x + 1) = 0.$$

From this $x - 1 = 0.$

$$\therefore x = 1,$$

and $x^2 + x + 1 = 0.$

By formula, $$x = \frac{-1 \pm \sqrt{-3}}{2}.$$

Ans. $1; \frac{-1 + \sqrt{-3}}{2}; \frac{-1 - \sqrt{-3}}{2}.$

First Year.—"Each wish contracting fits him to the soil."

This may be read in two ways—

(1) Each wish contracting (sub.) fits (predicate) him (obj.); or,

(2) He, contracting each wish—fits—himself to the soil.

Of these the former is preferable, since the latter would imply that the Swiss *purposely* limited his desires in order to be content, a meaning which is not in agreement with the other remarks.

Français.—You will find *Le Roi des Montagnes* (Practical Teacher edition) very good practice. The tale itself is amusing and interesting, and this edition is well annotated, and possesses a vocabulary.

Puzzled.—"A person started at 2.30 and walked to a village, arriving there when the church clock indicated 3.15. After staying 25 minutes, he drove back by a road one-fourth as long again, at a rate twice as fast as he walked, and reached home by 4. How far wrong was the church clock?"

Solution :—He was away altogether 1½ hours, or 90 minutes, of which 25 minutes were spent in resting. The actual time of travelling was therefore 65 minutes. Assuming the distance walked to be 4, the distance back was 5. But if the time taken to walk was 4, the time taken to drive was 2½. Therefore the 65 minutes must be divided in the ratio 4 : 2½ or 8 : 5 = 40 : 25. He took 40 minutes to walk, and reached the church at 3.10. The clock, which said 3.15, was therefore 5 minutes fast.

(*Other Correspondents answered by post.*)

OUR CERTIFICATE COURSE FOR 1901.

BY GEORGE COLLAR, B.A., B.SC.,

Head-Master of the Stockwell Pupil Teachers' School.

TEST QUESTIONS ON LAST MONTH'S WORK.

Theory of Teaching.

1. What special points should be attended to in teaching writing so as to secure speed without, at the same time, sacrificing legibility?

2. How are propositions classified? Say to which class the following belong :—

   (*a*) Some animals are warm-blooded.
   (*b*) All fishes are vertebrates.
   (*c*) Oysters are not vertebrates.
   (*d*) This pond is covered with ice.
   (*e*) Other ponds are not frozen.

3. Explain, with illustrations, the relations between (*a*) contradictory, (*b*) contrary, (*c*) subcontrary, and (*d*) subaltern propositions.

Arithmetic.

1. Distinguish between compound and complex fractions.

2. State and prove the rule for the division of one vulgar fraction by another. What graphic illustrations would you employ in teaching it?

Geography.

Both Years.—1. Trace the rise of the kingdom of Prussia.

2. What modifications did the boundaries of the French kingdom undergo during the reign of Louis the Fourteenth?

History.

Both Years.—1. What was the "Directory"? What difficulties were experienced by the Directory in carrying on the government of France?

2. Describe the campaigns against Austria which ended in the treaty of Campo-Formio.

3. What induced Napoleon to invade Egypt? Give a detailed account of the invasion.

Algebra.

Women—Both Years.—Resolve the following expressions into factors :—

(i.) $1 - x^2 + 6xy - 9y^2$.
(ii.) $x^4 - 3x^2y - 28y^2$.
(iii.) $a^2 + 2ab + b^2 - 4x^2 - 4xy - y^2$.
(iv.) $x^4 + 5x^2y^2 + 9y^4$.
(v.) $4a^4 + 24a^2y^2 + 35y^4$.

Men—First Year.—1. Write a quadratic equation whose roots shall be the reciprocals of the roots of $x^2 + px + q = 0$.

2. Solve the equations:—

(i.) $$\frac{x+4}{x-5}-\frac{2x-2}{x-4}=\frac{4}{x-6}-\frac{x-2}{x-3}.$$

(ii.) $$\begin{cases}\dfrac{x-2b}{x-3b}+\dfrac{y-4a}{y-3a}=2.\\[2ex] \dfrac{x+2b}{x+b}=\dfrac{y+5a}{y+3a}.\end{cases}$$

MEN—SECOND YEAR.—1. Find four numbers in geometrical progression so that their sum may be 15, and the sum of their squares 85.

2. Show that $2^{\frac{1}{2}}\cdot 4^{\frac{1}{4}}\cdot 8^{\frac{1}{8}}\cdot 16^{\frac{1}{16}}=2$.

NOTES AND SYLLABUS FOR OCTOBER.

ENGLISH COMPOSITION.

Prepare essays on the following subjects:—

1. Thrift and avarice compared.
2. The pleasures of hope.
3. Our English cathedrals.

THEORY OF TEACHING.

SECOND YEAR.—Methods of teaching arithmetic to the end of vulgar fractions. The following are the special points to consider:—

(*a*) The nature of number, and how the idea of number in the abstract may be imparted to very young children.

(*b*) The methods of teaching the decimal notation to children.

(*c*) Addition and subtraction, with especial reference to the theory underlying the methods of teaching subtraction. *Complementary addition* is the simplest, and enables addition and subtraction to be taught simultaneously.

(*d*) Multiplication. The relation of the partial products to the final result. The place value of the digits in the partial products must be carefully explained. Methods of building up the tables and teaching them.

(*e*) Division. Its relation to subtraction and to multiplication.

(*f*) Relation of the compound to the simple rules.

(*g*) Theory of numbers, so far as required for H.C.F. and L.C.M., together with tests of divisibility.

(*h*) Proofs of the rules for operating on vulgar fractions, and illustrations employed in teaching the rules.

Logic.—This month the student must endeavour to arrive at a satisfactory answer to the question, "What is knowledge?" In Lesson vii. Jevons gives a summary of Leibnitz's theory on the subject. The student will see here that our knowledge of one thing may be totally different in kind from our knowledge of something else. Welton has a valuable chapter on knowledge and the method by which it is gained. The student who thoroughly masters Welton, chap. viii., and Jevons, chap. vii., will have made a substantial advance.

ARITHMETIC.

Theory of Decimals.—It is not sufficient to be able to obtain results in examples by rule of thumb methods; the principles must be thoroughly mastered.

Special attention should be paid to the contracted methods of multiplication and division. Although in the Certificate Examination candidates are allowed to work by any methods they please, and marks are not deducted for unnecessarily long working, yet the candidate who does not adopt the shortest methods imposes a heavy penalty on herself in the loss of valuable time out of the time allowed for the whole paper. Chapters xxii. and xxiii. of Christian and Collar's *Arithmetic* not only give a full treatment of the theory, but set out several short methods of working based upon the theory.

The proof of the chief theorems connected with recurring decimals is an absolute necessity.

ENGLISH GRAMMAR AND LITERATURE.

FIRST YEAR.—*Lyra Heroica*, LXIV.–LXXXIII.

Iphigeneia (spelt also Iphigenia, and accented on the last syllable but one). Agamemnon, one of the leaders of the Greeks at the time of the Trojan War, had made a vow to Artemis—that is, Diana—that he would offer as a sacrifice the most beautiful thing that came into his possession during the next year. His infant daughter was universally proclaimed the most beautiful possession of her father. Agamemnon, however, regretted his vow, and the sacrifice was not made. When the Greek expedition reached Aulis, and was there becalmed, the absence of wind was attributed by the seer Calchas to the wrath of Artemis, annoyed by the non-fulfilment of the vow. Thereupon Agamemnon prepared to sacrifice Iphigenia; but Artemis accepted his intention, and rescued Iphigenia from the altar.

Athena—that is, Minerva—the goddess of learning and the arts.

LXV., LXVI., LXVII. Campbell's poems mostly re-echo the spirit of his times, and are intensely patriotic. The rhythm of his verse is always particularly well marked.

Argo. The name of the mythical ship in which Jason and his companions went in search of the golden fleece. Its mariners were hence called the Argonauts.

LXVII. See the history notes for next month.

Adamantine lips. The iron muzzles of the guns. Adamantine is derived from a Greek word meaning "unconquerable," and the word adamant meant either a diamond or a magnet.

LXX. Notice the way in which the two halves of each stanza are united—namely, by repeating the fourth line to form the fifth.

On the lee. The side towards which the wind is blowing.

LXXI. Our English lyrical poetry is particularly rich in poems relating to the sea. This is a fine spirited sea-song.

LXXII. Notice the three pictures—(*a*) the arrival of the Assyrian host; (*b*) the result of the visit of the Angel of Death; (*c*) the lament of the widows. See how the poet shows his art by relating (*a*) and (*b*) by contrasts, and by leaving the mind to supply the connection between (*c*) and (*b*). Notice the figures of speech—principally similes.

Sappho. A Greek poetess. Fragments only of her writings remain.

Delos. The smallest island of the group called the Cyclades. Neptune is said to have made it rise from the deep with his trident.

Phœbus. The same as Apollo, the sun-god.

Marathon. A plain about twenty-five miles from Athens, where the Greeks overthrew the Persians, who were invading their country.

A king—that is, Xerxes, king of Persia, whose fleet was destroyed by the Greeks at Salamis, an island to the west of Athens, B.C. 480.

Thermopylæ. A mountain pass defended by three hundred Spartans against the Persian host. The three hundred were overcome through treachery, and died on the spot.

Bacchanal. A follower of Bacchus, the god of wine.

Pyrrhic. Pertaining to Pyrrhus. Pyrrhus was a Greek leader who gained an entrance into Troy by concealing himself in the wooden horse.

Cadmus is said to have introduced the alphabet into Greece.

Anacreon. A writer of poems in praise of wine.

Polycrates. Tyrant (or irresponsible monarch) of Samos, a patron of artists and poets, including Anacreon.

Chersonese. The peninsula to the north-west of the Dardanelles. An Attic colony settled there under Miltiades, the general who commanded the Greeks at Marathon.

Heracleidan. Descended from Hercules.

Swan-like. The song of a dying swan is said to be very sweet.

LXXXI. *All but he.* The grammar of this line is often criticised. It is, however, quite correct; "but" is only a conjunction.

LXXXIII. The reader is advised to read more of the poems of Keats, who is so scantily represented in our collection.

SECOND YEAR.—Read Macaulay's *Life and Letters*, chap. vi., and from this chapter draw up a connected account of Macaulay's doings in India. This period of his life is very important, and, from the account given in this chapter of the way in which Macaulay devoted himself to his duties, the reader will see how the writer of the Essays on Clive and Warren Hastings qualified himself for his task.

Study carefully *Paradise Lost*, Book II., lines 1–416. (See last year's notes in THE PRACTICAL TEACHER.)

GEOGRAPHY.

BOTH YEARS.—Having traced the steps by which the political divisions attained the condition in which we find them at the beginning of the special period we have to study, we will now turn aside to review the physical geography of Europe (*a*) in broad outlines, and then (*b*) in such detail as may be necessary for our purpose.

In studying the general build of the continent, notice—

The great Alpine system of mountains. Starting from its junction with the Apennines, (*a*) the Maritime Alps run west, and shelter the Riviera, or district along the coast of the Gulf of Genoa. North of these come (*b*) the Cottian and (*c*) Graian Alps, with Monte Viso and Mont Cenis. Next (*d*) the Mont Blanc group—an immense mountain mass from which the (*e*) Pennine Alps run eastward. This mass is about sixty miles

long and fifteen or twenty broad, with numerous transverse valleys running north and south, and leaving such peaks as the Great St. Bernard, Dent Blanche, Weisshorn, Matterhorn, Breithorn, Lyskamm, Monte Rosa (second highest in Europe), and the Michabelhorn (third highest in Europe). We might, indeed, regard this mass as including the (*f*) Bernese Oberland, on the north side of the Rhone valley. The mass has, however, been divided into two by the formation of the upper Rhone valley by glacial action. At present the Rhone Glacier is only some two or three square miles in extent, but in the "Glacier Period" it stretched right out into the middle of France; in fact, the city of Lyons is built on what was formerly its terminal moraine. In the Bernese Oberland we have such peaks as Finsteraarhorn, the Aletschhorn, Monch, Eiger, and Jungfrau. The (*g*) Lepontine Alps run east from the Pennine Alps, and join the Bernese in the grand elevated mass of Mont St. Gotthard. Numerous spurs run off from this, and the main ridge is continued through (*h*) the Rhætian Alps, south-east of the Upper Engadine, with its peaks, such as Piz Bernina and Piz Languard; but the student must remember that the whole district is high—in fact, the villages of Pontresina, Silva Plana, and St. Moritz, at the bottom of the valley, have an elevation of 5,000 or 6,000 feet above the sea-level. In the Tyrol we may consider the mountain mass to divide; the south-east chain is formed by the (*i*) Carnic and (*j*) Julian Alps, which run on to the Dinaric Alps and plateau of Montenegro and Herzegovina and the mountain country of Turkey and Greece. To the north-east the elevation is continued through the Noric Alps to the Little Carpathians, to the north-west of which lies the table-land of Bohemia, surrounded by the Bohmer Wald (south-west), Erz Gebirge (north-west), and the Riesen Gebirge and Sudetic Mountains (north-east). Thence, encircling Hungary, come (*k*) the Carpathians and (*l*) Transylvanian Alps; and these, in spite of the Danube breaking through at the Iron Gate, are really continuous through the Planina Mountains, with the (*m*) Balkans, (*n*) the Despoto Dagh, and other mountains of Turkey and Greece. This system must be carefully studied, as it gives the key to the whole structure of Europe.

A second mountain mass forms practically the whole of Norway. The northern part is called the Kiolen Mountains; the southern part consists of ill-defined groups known as the Dovrefjeld and Hardanger Fjeld. In these, deep valleys have been worn out by glacier action, and in many cases these valleys extend right into the sea, and constitute the fjords.

The other elevated part of Europe is the Iberian Peninsula, in which wide valleys have been formed, leaving the ridges Sierra Nevada, Sierra Morena, Sierra de Toledo, mountains of Castile, and Cantabrian Mountains, which are practically continuous with the Pyrenees.

If the student thoroughly masters the disposition of the mountain masses, there will be little difficulty felt in studying the plains.

Study also the international rivers—that is, those which run through or between two or more countries.

Trace out on the map of Europe the campaigns described in the history notes of this month and last month. Then take blank maps of Europe, and practise illustrating the campaigns.

Make a point of finding on the map the position of every place mentioned in the history course.

History.

Both Years.—We have seen that Napoleon overthrew the Directory and secured the establishment of a Consulate, with himself as First Consul. This constitution was in the main the work of the Abbé Sieyès, whose brain was remarkably fertile in constitutions—in fact, he devised more of them that were put into practice than any man that ever lived. The idea of Sieyès was to have a "Grand Elector," who should have no particular political powers, but should make the appointments to the chief offices of state. The real power was to rest with two consuls, as in the early history of Rome, one having the direction of home affairs, the other of foreign affairs. Sieyès thought to find in Napoleon a tool to carry out his plans, but Napoleon soon showed that he was master of the situation, and when the Consulate was established he became "First Consul," with nearly all the real power in his hands. This power included the absolute direction of the military forces, and the appointment of all high functionaries, including the judges. He alone could propose a law, and when passed all laws had to be promulgated by him. The appearance of liberty was maintained by the appointment of four assemblies to discuss the laws before they could become effective. The Council of State (*Conseil d'État*) drew up the proposals of the First Consul in the form of bills, after which they were submitted to the Tribunate (*Tribunat*) of a hundred members, where they were supposed to receive amendments likely to make them more acceptable to the people. They were next passed to the consideration of the Legislative Body (*Corps Législatif*) of three hundred members, before whom three Councillors of State set out the arguments in their favour, and three Tribunes the arguments against. The Legislative Body then voted on the projects without being able to speak for or against them. Finally they came before the Senate, whose special function was to see that the bills were not contrary to the constitution, and, if passed, were promulgated by the First Consul.

In spite of the faulty political principles on which the Consulate was founded, it accomplished a vast amount of useful legislative and administrative work.

(1) The system of taxation was largely remodelled, and by the establishment of the *Banque de France*, which aided the government, and in return had a government guarantee, the public finances were soon raised from the disastrous state into which they had lapsed.

(2) The judicial system was remodelled. The chief judges were appointed for life. Minor civil cases were settled in the *Cours de Première Instance*, more important ones in the *Cours d'Appel*. For criminal cases there were established (*a*) in every canton a *Tribunal de Simple Police*, (*b*) in every arrondissement a *Tribunal Correctionnel*, and (*c*) in every department a *Cours d'Assises*.

The laws which these courts were called upon to administer were systematised and arranged in Codes. The first of these, published in 1804, was the *Code Civil* or *Code Napoleon*.

Another very important measure was the *Concordat*, an agreement by which church and state were brought into agreement. The church property seized by the state could not be restored, so the state as a set-off agreed to pay salaries to the clergy. The state also gained the right to appoint the bishops.

The state also took in hand public education. We have given these details because they show the steps taken by Napoleon to strengthen France, conciliate the different factions, and prepare to meet the hostile armies. At the time of the Second Coalition the French had to defend a line stretching from the North Sea to the Gulf of Taranto. Massena occupied Switzerland, which commanded the principal valleys of Central Europe. He was supported by General Schérer on the Adige, and Macdonald at Naples; while on his left he had Jourdan in the upper Danube valley, and Brune in Holland. The allies endeavoured to cut the French forces in three by concentrating their attacks on Jourdan and Schérer. They succeeded in defeating Jourdan at Stokach, north of Lake Constance, and driving him across the Rhine. Schérer was defeated at Magnano, near Verona; and Moreau, who succeeded him, was defeated at Cassano, on the Adda. Fearing that he would be cut off, Macdonald hurriedly retired from Naples, and after the battle of Trebbia withdrew altogether from Italy. When Joubert tried to reconquer the peninsula, he was defeated and killed at Novi.

Toward the autumn of this year (1799) fortune suddenly turned in favour of the French. The Anglo-Russian troops, in endeavouring to envelop Brune, were defeated at Bergen-op-Zoom. In Switzerland, Massena met the attacks of Souwarrow by a clever series of manœuvres, and gave him a crushing defeat at Zurich. As a result of this defeat Russia withdrew from the coalition. Another result of this battle was to cut the Austrian forces in two. One of these divisions was awaiting the French near Strasburg, but Moreau avoided it by passing farther south through Mülhausen, and after defeating detachments of Austrians at Eugen, Maeskirch, and Hochstett, he entered Munich (May 1800).

The campaign against the Austrians in Italy was directed by Napoleon himself. Whilst the Austrians were losing many men in the ineffectual siege of Genoa, which was defended by Massena, Napoleon secretly collected an army in Valais and crossed the St. Bernard Pass. Leaving Lannes, who had defeated an Austrian force at Montebello, to occupy Piedmont, Napoleon pushed on to Milan to clear the Austrians from Lombardy. He then returned and met the Austrians, who had raised the siege of Genoa, at Marengo (June 14, 1800). The battle was hotly contested, but resulted in a signal defeat for the Austrians, who were obliged next day to sign the Convention of Alessandria, by which they agreed to retire beyond the Mincio, and abandon the whole of Piedmont and Lombardy to the French.

As the Austrians still refused to make peace, Moreau moved his army from Munich, and utterly routed the army of the archduke at Hohenlinden (December 3, 1800), and captured Linz, the capital of Upper Austria. Then the Austrian Government signed the peace of Lunéville, by which Belgium, Piedmont, and Lombardy were left in the hands of France, and England was left to continue the struggle alone.

The naval power of Great Britain made this struggle so peculiar that we must begin a special study of it next month.

Meanwhile we will just refer to the events in Egypt. Great Britain was assisting the Turks to re-establish their power in Egypt, and Kléber, who commanded the French after the departure of Napoleon, had signed the Convention of El Arisch, by which he agreed to evacuate Egypt. This convention was repudiated by the government, and after Kléber had been assassinated, and his successor defeated at Canopa, the remnant of the French army capitulated at Alexandria, and was transported to Toulon on English vessels.

Algebra.

Women—Both Years.—L.C.M. and operations with fractions.

We will work out the examples set at the last Certificate Examination.

1. Reduce to its lowest terms—

$$\frac{18a^3 + 57a^2b + 24ab^2 - 15b^3}{45a^4 + 30a^3b + 12a^2b^2 + 18ab^3 - 9b^4}.$$

This cancels at once by 3. Then trying for factors in the numerator, we see that $(a - b)$ is *not* a factor, because the sum of the coefficients does not vanish; but $(a + b)$ is a factor, because by changing the signs of the coefficients of the terms involving uneven powers of a, the sum of the coefficients does vanish; and applying this test to the denominator, we find $(a + b)$ is a factor of that also. The other factors are found by division. Thus the fraction

$$= \frac{3(a + b)(6a^2 + 13ab - 5b^2)}{3(a + b)(15a^3 - 5a^2b + 9ab^2 - 3b^3)}.$$

Treating the expression $(6a^2 + 13ab - 5b^2)$ in the way we recommended in a recent number, we find that it equals

$$\frac{(6a + 15b)(6a - 2b)}{6} = (2a + 5b)(3a - b).$$

Consequently, if there is another common factor, it must be either $(2a + 5b)$ or $(3a - b)$. It is useless to try the first, because the last term of the expression in the denominator—namely, $-3b^3$—is not divisible by $+5b$. But we see at a glance that $(3a - b)$ is a factor of $15a^3 - 5a^2b + 9ab^2 - 3b^3$, because the expression vanishes if we substitute $3a$ for b. Hence the fraction becomes

$$\frac{3(a + b)(3a - b)(2a + 5b)}{3(a + b)(3a - b)(5a^2 + 3b^2)}; \text{ that is, } \frac{2a + 5b}{5a^2 + 3b^2}.$$

2. Simplify $\dfrac{5(x + 5)}{x^2 + x - 6} - \dfrac{2(x + 2)}{x^2 - 2x - 15} - \dfrac{3(x + 3)}{x^2 - 7x + 10}$.

(i) Factorise the denominators, and the expression

$$= \frac{5(x + 5)}{(x + 3)(x - 2)} - \frac{2(x + 2)}{(x - 5)(x + 3)} - \frac{3(x + 3)}{(x - 2)(x - 5)}$$

$$= \frac{5(x + 5)(x - 5) - 2(x + 2)(x - 2) - 3(x + 3)(x + 3)}{(x - 2)(x + 3)(x - 5)}$$

$$= \frac{5x^2 - 125 - 2x^2 + 8 - 3x^2 - 18x - 27}{(x - 2)(x + 3)(x - 5)}$$

$$= \frac{-18x - 144}{(x - 2)(x + 3)(x - 5)} = \frac{-18(x + 8)}{(x - 2)(x + 3)(x - 5)}.$$

The equations set were very simple. In simplifying (c), the terms of the third fraction alone should be multiplied by 2, thus—

$$\frac{2}{x - \frac{1}{2}} = \frac{4}{2x - 1}.$$

The equation is then best worked as follows:—

$$\frac{1}{2(x - 3)} - \frac{3}{1 - 2x} = \frac{4}{2x - 1} + \frac{2}{3(x - 3)}.$$

Adding $\dfrac{3}{1 - 2x} - \dfrac{2}{3(x - 3)}$ to each side,

$$\frac{1}{2(x - 3)} - \frac{2}{3(x - 3)} = \frac{4}{2x - 1} - \frac{3}{2x - 1};$$

that is, $\dfrac{3 - 4}{6(x - 3)} = \dfrac{4 - 3}{2x - 1}$;

that is, $6x - 18 = -2x + 1$,

$8x = 19$,

$x = 2\frac{3}{8}$.

Men—First Year.—Quadratic equations involving more than one unknown. These should be studied in classes. If one of the equations is of the first degree, the simplest method of solving is to get the value of one unknown in terms of the other from this equation and substitute in the other.

$$\begin{cases} bx + ay = a + b. & \text{(i)} \\ xy = 1. & \text{(ii)} \end{cases}$$

(First Year Men, 1900.)

From (i), $x = \dfrac{a + b - ay}{b}$.

Substituting this value in (ii), $\dfrac{ay + by - ay^2}{b} = 1$.

$$\therefore ay^2 - ay - by + b = 0.$$

$$(ay - b)(y - 1) = 0.$$

$$\therefore y = 1 \text{ or } \frac{b}{a}.$$

$$\therefore x = 1 \text{ or } \frac{a}{b}.$$

Should both equations be homogeneous and of the second degree, the best method is to find the ratio between x and y—that is, let $x = my$, and then determine the value of m.

The importance of skill in factorising is shown by such questions as No. 3 in the recent Certificate Examination.

$$\frac{\sqrt{(x^2 + x - 12)(x^2 - 7x - 44)(x^2 - x - 6)(x^2 - 9x - 22)}}{(x^2 - x - 6)(x^2 - x - 20)}$$

$$= \frac{\sqrt{(x + 4)(x - 3)(x - 11)(x + 4)(x - 3)(x + 2)(x + 2)(x - 11)}}{(x - 3)(x + 2)(x - 5)(x + 4)}$$

$$= \frac{(x + 4)(x - 3)(x - 11)(x + 2)}{(x - 3)(x + 2)(x - 5)(x + 4)} = \frac{x - 11}{x - 5} = 1 - \frac{6}{x - 5}.$$

This is true for all values of x, provided we agree that $\sqrt{a \times a} = a$ whether a is positive or negative. As a matter of fact, if a is a negative quantity, $a \times a$ must be positive; but the root of a^2 may also be taken as positive, and therefore equal in value, but of opposite sign to a.

In proving the second part, the working is very long unless you remember that

$$3 = 1 + 1 + 1 = \frac{b + c}{b + c} + \frac{c + a}{c + a} + \frac{a + b}{a + b}.$$

If you substitute this value for 3, the expression becomes

$$\frac{a}{b + c} + \frac{b + c}{b + c} + \frac{b}{c + a} + \frac{c + a}{c + a} + \frac{c}{a + b} + \frac{a + b}{a + b}.$$

Adding these in pairs, we obtain

$$\frac{a + b + c}{b + c} + \frac{a + b + c}{c + a} + \frac{a + b + c}{a + b},$$

whence we get

$$(a + b + c)\left(\frac{1}{b + c} + \frac{1}{c + a} + \frac{1}{a + b}\right).$$

Men—Second Year.—The binomial theorem for positive integral indices.

Continue to practise examples which require factorising. The first example in the last Certificate Examination shows the advantage of skill with factors.

1. Simplify—

$$\left\{\frac{a^2 + ab + b^2}{a^2 - ab + b^2} - \frac{a^2 - ab + b^2}{a^2 + ab + b^2}\right\} \div \frac{4ab(a^4 - b^4)}{a^6 - b^6}.$$

This equals

$$\frac{(a^2 + ab + b^2)^2 - (a^2 - ab + b^2)^2}{(a^2 - ab + b^2)(a^2 + ab + b^2)} \times \frac{(a^3 - b^3)(a^3 + b^3)}{4ab(a^2 + b^2)(a + b)(a - b)}$$

$$= \frac{(2a^2 + 2b^2)(2ab)}{(a^2 - ab + b^2)(a^2 + ab + b^2)} \times \frac{(a - b)(a^2 + ab + b^2)(a + b)(a^2 - ab + b^2)}{4ab(a^2 + b^2)(a + b)(a - b)}$$

$$= 1.$$

Euclid.

Women—First Year.—Props. 16–26.

Compare 18 and 19 with 5 and 6 respectively. What is the reason for the limitation in the enunciation of 22? Be careful not to speak of "a triangle equal to three given straight lines." The triangle is the area. Notice that the expression is "a triangle *whose sides* are equal to three given straight lines."

Compare 24 and 25 with 4 and 8 respectively.

Women—Second Year.—Finish Book II.

Men—First Year.—Book III. to end of Prop. 19.

Men—Second Year.—Book VI. to end of Prop. 13.

Latin. See Matriculation Course.

French.

Learn the irregular verbs of the first and second conjugations, noticing where the irregularities come in.

Read *Le Roi des Montagnes*, pages 65–116; translate the exercises ix. to xiv.

Give a neat English rendering of the following:—

Le train venant de Nantes, qui doit s'arrêter à Vannes à dix heures vingt minutes du matin, allait bientôt arriver.

A la suite des voitures rangées dans la cour de la gare, mais à une certaine distance d'elles, se trouvait un char à bancs à quatre roues, attelé de deux petits chevaux qu'une jeune fille, assise sur le siège de devant, retenait difficilement.

LONDON MATRICULATION.

JUNE 1901.

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LATIN COURSE FOR OCTOBER.

1. Sallust, *Catiline*, chaps. xvii.–xxiv.

2. Grammar.—The numerals and pronouns in the accidence; in the syntax, the accusative and dative cases. Note the definition of a transitive verb.

3. *Anglicè Reddenda*, Nos. 21–30.

4. Sentences to be worked from Bradley's *Arnold* or Bayfield's or Allen's *Exercise Book*.

Notes on Grammar.

The numerals—cardinal, ordinal, distributive, and adverbial—are most important. Note that distributives are used (*a*) to denote "so much a piece;" (*b*) with nouns that have no singular, or that have a different meaning in the singular, as *quaternae litterae*, "four epistles;" *quatuor litterae*, "four letters of the alphabet;" (*c*) in multiplication, as *bis bina sunt quatuor*, "twice two are four." Be able to give a list of the numerals that are (*a*) declinable, (*b*) indeclinable, (*c*) sometimes declinable and sometimes indeclinable, like *mille*. Note that *unus* is used in the plural with words plural in form but singular in meaning, as *una castra*, "one camp." Distinguish *triceni*, "thirty a piece," and *treceni*, "three hundred a piece." *Mille* in the singular is generally used as an adjective—for example, *mille equites*, "1,000 horsemen;" though *mille equitum* is also found in Cicero. In the plural *mille* is a noun, and requires the genitive—for example, *duo milia equorum*, "2,000 horses." (*N.B.*—*Milia* is a better spelling than *millia*.)

Note that *quis* is an interrogative pronoun; *qui*, an interrogative adjective or relative pronoun; *quid*, interrogative pronoun; *quod*, interrogative adjective. You must know thoroughly how to decline the various pronouns.

Note the chief syntactical usages of the accusative case—(*a*) in prose, (*b*) peculiar to poetry or poetical prose. Apart from the accusative in dependence on a transitive verb—a construction, of course, common in every language—note the accusative of space and duration of time. In the latter case we often in English use the preposition "for"—for example, "he reigned for twenty years," *viginti annos regnavit*.

Note the classes of verbs that are followed by two accusatives, and also what becomes of the two accusatives when the construction becomes passive. Among the verbs of asking that do *not* admit of a double accusative are *peto*, *quaero*, and *postulo*.

Note that "ago" is expressed by *abhinc* and the accusative. The examples quoted in some grammars of *abhinc* and the ablative are very doubtful. You should know the list of prepositions that govern the accusative.

The accusative of "motion to," without a preposition, in the case of names of towns or small islands, we have already alluded to in our sentences.

In poetry an accusative of "respect" is sometimes used, especially of parts of the body—for example, *humeros nudus*, "with bare shoulders" (literally, "bare as to the shoulders"). This is a Græcism, or construction borrowed from the Greek.

Another poetical construction is the accusative of "motion to," *without* a preposition, in the case of words which are *not* names of towns or small islands.

The adverbial accusative is commoner in poetry than in prose. The cognate accusative is important—for example, *dulcem ludum ludere*. In poetry you find a so-called "extended cognate accusative"—for example, *coronari Olympia*, "to be crowned at the Olympic games."

It is very important to know the classes of verbs that govern the dative, as English equivalents of most of these verbs are transitive. Note as well that if the verb in the active does not govern the accusative case, it is used impersonally in the passive; hence *parco tibi*, "I spare you," becomes in the passive *tibi parcitur*, not *parceris*.

Among the verbs governing the dative the following are most important, and students should be able to construct sentences showing their construction:—*impero*, *credo*, *consulo*, *invideo*, *expedit*, *noceo*, *licet*, *nubo*, *persuadeo*, *faveo*, *auxilior*, *indulgeo*, *minor*, *placeo*, *adimo*, *æmulor*, *resisto*, *subvenio*, *pareo*, *parco*, *adversor*, *studeo*, *irascor*, *maledico*, *accidit*, *medeor*, *confido*, *obedio*, *libet*, *contingit*. Some of these verbs also govern the accusative. For example, *impero* requires the accusative of the thing requisitioned—*obsides impero civitati*, "I order the state to supply hostages" (literally, "I order hostages to the state"). *Consulo*, meaning (*a*) "to consult a person," governs the accusative; (*b*) "to consult a person's interests," takes the dative: *consulo in aliquem* means, "I take measures against some one." *Invideo* takes the accusative of the thing grudged, the dative of the person envied, or to whom a thing is grudged—for example, *invideo tibi*, "I envy you;" *hoc tibi invideo*, "I grudge you this." *Credo* governs the accusative of the thing, and dative of the person; *minor* has the same construction—for example, *ei mortem minamur*, "we threaten him with death" (literally, "we threaten death to him"). *Adimo* and *aufero* govern the accusative of the thing taken away, and the dative of the person from whom the thing is taken—for example, *hoc tibi adimo*. The verbs *iubeo*, *laedo*, *delecto*, *sino*, etc., which, contrary to the general rule, govern the accusative, are important. Contrast *milites iubet hoc facere* and *militibus imperat ut hoc faciant*, "he orders the soldiers to do this."

Be able to give a definition and example of the following terms:—ethical dative, predicative dative, adjectival dative, double dative (that is, the dative of the person and the predicative dative in combination), dative of advantage and disadvantage (*dativus commodi* and *incommodi*). Note that the dative of the agent is used with the gerundive.

Typical Sentences.

7. "Who could have told your father to favour those soldiers?"

Quis patri tuo ut his militibus fareret dicere potuit?

Notes.—(*a*) Whenever "to" and the infinitive in English express a purpose, the infinitive must not be used in Latin prose. One of the commonest ways of expressing the infinitive in such cases is by using *ut* (= "in order that") and the subjunctive. If the infinitive has a negative attached to it, *ne* is used instead of *ut*—for example, *te rogavi ne hoc faceres*, "I asked you not to do this." From this we deduce the following rule:—After verbs denoting "ask," "command," "persuade," "advise," "strive," and similar verbs, "to" and the infinitive are translated by *ut* and the subjunctive. (*b*) For the tense of *faveret*, see last month. The action of "injuring" is future to that of "telling," hence the imperfect subjunctive is used. (*c*) *Faveo* governs the dative.

8. "Let the soldiers prevent my father from sacrificing the interests of the Romans to his own."

Milites patrem meum prohibeant ne se Romanis anteponat (or, *sibi Romanos posthabeat*).

Notes.—(*a*) Verbs of preventing, when followed in English by "from" and a verbal noun, are generally followed in Latin by *quominus* ("by which the less") or *ne* ("lest") with the subjunctive. *Obstare* also means "to prevent," but, unlike *impedio*, which is a transitive verb, governs the dative. *Prohibeo* is generally followed by *ne* and the subjunctive, or by the infinitive, more rarely by *quominus*. (*b*) Beware of looking out in th: English-Latin dictionary and writing down a literal translation of "sacrifice." Metaphor must be cautiously treated in Latin, and it is better for the beginner to avoid retaining the metaphor in his Latin version. Turn the metaphor into unmetaphorical English. Applying this process to this sentence, we get as a result, "to prefer himself to the Romans:" "to prefer," in this sense, is *antepono*. *Posthabeo* could also be used = "hold second to." Literally, the version in brackets will be, "hold the Romans second to himself." (*c*) The present subjunctive is used because the action of sacrificing is future to that of preventing. (*d*) "Let" is expressed by the present subjunctive. If there were a negative, the negative would be *ne*.

9. "There are some who do not doubt that so wise a man as Balbus ought to have gone to you in Carthage."

Sunt qui non dubitent quin Balbus vir sapientissimus Carthaginem ad te ire debuerit.

Notes.—(*a*) "There are some who" is expressed by *sunt qui* and the subjunctive. The subjunctive is due to the fact that when *qui* has an indefinite antecedent expressed or understood, the subjunctive is required. (*b*) After negative or virtually negative verbs of doubting, *quin* with the subjunctive is used to express "that." A rough rule for the general use of *quin* is this: whenever "but that" can be used in English, then *quin* can be employed in Latin. (*c*) Many students will translate "so wise a man as Balbus" by *tam sapiens vir quam Balbus*. Now *tam.....quam* are used only when there is a comparison drawn between two people. In this sentence this is not the case, and in this and in similar instances the superlative is used. Note also that *sapientissimus Balbus* would not be good Latin; adjectives are not used with proper names unless the words *vir*, *femina*, etc., are also employed. (*d*) In English we use the prepositional phrase "at Carthage" as an adjunct to "you;" in

Latin this is not done, and the Latins attached the phrase to the verb, and said "to Carthage to you." For the accusative, see before. (c) Note the tense of the infinitive *ire*. After *debeo*, *possum*, etc., the perfect infinitive is not used, though the English equivalents of these verbs, "ought," "could," are followed by the perfect infinitive. The action of the "going" and the action of *debeo* are synchronous, therefore the present infinitive is used. In English, as "ought" is present and past, the past signification has to be expressed by using the perfect infinitive. This is not necessary in Latin, as *debeo* has a past tense.

Sentences.

(Readers can have their exercises corrected by sending them to the Editor, Matriculation Course, *P. T.*, and enclosing seven stamps.)

1. He cannot doubt that the citizens of Rome were terrified by Gaius.
2. On hearing that the troops were in Carthage, he said he would not go to Paris (*Lutetia*).
3. It cannot be doubted that he has prevented your father from going to Naples (*Neapolis*).
4. Balbus was with difficulty (*vix*) persuaded to stop a fortnight in the city of Rome.
5. How few there are (*quotus quisque*) who can blame the gallant (*fortis*) Cæsar.
6. Who will prevent these men from butchering the hapless citizens?
7. We shall not advise him to stop fifteen days in such a city as this.
8. No one doubts that the army was cut to pieces (*concido*) by the general.
9. The base Clodius will not be able to prevent us from going out of the city.
10. He knows that you are wiser than these men.

Test Paper.

(Readers can have their solutions corrected by sending them to the Editor, Matriculation Course, *P. T.*, and enclosing seven stamps.)

1. In what different ways are distributives used in Latin? Give examples.
2. Explain the terms—cognate accusative, accusative of respect, double accusative, ethic dative, dativus commodi. Give examples.
3. Correct or justify—
   (*a*) *Hi milites invidentur.*
   (*b*) *Hic ab hostibus laeditur.*
   (*c*) *Argentum civibus imperatur.*
   (*d*) *Tremit artus.*
   (*e*) *Iussit milites ut abeant.*
   (*f*) *Eum pacem petivit.*
   (*g*) *Factus est regem.*
4. Decline in conjunction—*acer* and *volpes*, *cupido* and *aliquis*, *domus* and *tacter*.
5. Distinguish between *nostrum* and *nostri*, *vestrum* and *vestri*, *memini eum dicere* and *memini eum dixisse*.
6. Decline *istaec urbs*.

ENGLISH COURSE FOR OCTOBER.

1. Grammar.—Pronouns. Nesfield, pp. 33–45, 147–155, 330–336.

The definition of a pronoun is important. You should also be able to classify pronouns and define each kind of pronoun. Of the various classes of pronouns, the relative and the personal pronouns are the most important from a Matriculation standpoint. A very common question is to discuss the usages, history, and etymology of the second and third personal pronouns. To answer that satisfactorily, you must point out that the usages of *thou* and *you* differed in Anglo-Saxon times, in the times of Elizabeth, and in the modern period. In Elizabethan days, *thou* was used in almost the same way as it is in modern French—namely, *thou* is used between intimate friends, as a term of contempt, and in elevated language. In the modern period, *thou* is used merely in elevated language. You must also point out that *ye* was the old nominative, and *you* was originally accusative and dative only, as we see from the Bible. Again, the possessive ending *r* in *your* and the double possessive ending in *yours* must be noticed. Note also that in earlier times *thy*, a shortened form of *thine*, was used before consonants, while *thine* was used before vowels. The *e* in *thine* is an expedient to show that the *i* is long. The *y* of *you* also requires comment.

Again, in discussing the third personal pronoun, you should give the original forms in Anglo-Saxon, and point out how the feminine form *her* was replaced by *she*. You should also point out that the plural of the article replaced the original *hi*, etc. With regard to *it*, you should notice the dropping of the original aspirate, and also that *his* was up to Shakespeare's time the regular neuter possessive form. In Shakespeare we find also *it* used as possessive—for example, "The hedge sparrow had *it* head bit off by *it* young." We do not find *his*. Note also in the Bible, "Of beaten work shall the candlestick be made, *his* shaft of the same." You should note the genitive feminine suffix in *her* (possessive), and the dative feminine suffix in *her* (dative). Note that the original dative forms *her* and *him* took the place of the old accusative forms *hi* and *hine*. The old accusative is still found in common talk—"I saw 'un."

Note the neither suffix *t* in *it*; compare *what* and *that*. Note why *its* has no apostrophe. *Them* was originally dative only, but took the place of the old accusative plural *hi*.

You should be able to discuss the following questions:—"Is it correct to say that 'we' is the plural of 'I'?" "Are 'he,' 'she,' and 'it' really personal or demonstrative pronouns?" The history and usage of the relative pronouns are most important. Remember that the original relative was *that*. In the early stages of a language relative clauses are not used. The construction is *paratactical*, not *hypotactical*, just as in the letter of a very young boy all the sentences are generally principal sentences. *That* was originally demonstrative only, then became relative. Afterwards the interrogatives *who*, *which*, and *what* were used as relatives; the relative *that* fell into disuse, but came in again, and was regarded by Addison—whose strong point was not scientific philology—as an interloper, and christened the "Jack Sprat that." Note how the usage of *which* has changed. Formerly it was applied to persons as well as to things (compare "Our Father which art in heaven"). Note the palatalisation in *which*, as well as the metathesis of *h* and *w*, found also in the other relative and interrogative pronouns. Note the *e* in *whose*, the etymological device to show that the *o* is long; compare *mine* and *thine*. *Whose* is now generally limited to persons. *Whom* was originally dative only. *As* is used as a relative after *such* and the *same*. Note the chief syntactical rules affecting pronouns. Note especially when the relative pronoun may be omitted—an idiom not found in Greek, Latin, or French.

2. History.—From the accession of William the Second to the death of John.

GEOMETRY COURSE.

Finish the reading of Euclid's First Book, and also read some of the worked-out problems found at the end of Book I. in Hall and Steven.

Solutions to riders set in our first course:—

1. Let ABC be a triangle; bisect the angle BAC by a straight line, cutting BC in D.

Then, by I. 16, $\angle$ ADC is greater than $\angle$ BAD, and $\angle$ BAD $= \angle$ CAD.

$\therefore$ $\angle$ ADC is greater than $\angle$ DAC.

$\therefore$ by I. 18, AC is greater than CD.

Similarly, AB can be shown to be greater than DB.

$\therefore$ AB and AC are together greater than BC.

2. Let BC be the given base; produce it both ways to E and F, so that EB = BC = CF. With centre B and radius BF, and centre C and radius CE, describe circles cutting at A. ABC will be readily seen to be required triangle.

3. Let AD cut BC in E. Then, by I. 4, triangles ABE, DBE are equal in all respects, and hence the angles BEA, BED are equal.

4. By I. 20, OA and OB are greater than AB,
   OB and OC are greater than BC,
   OC and OA are greater than AC.

Adding and halving, then the sum of OA, OB, and OC is greater than half sum of AB, BC, and CA.

If O and A coincide, OA will be zero, and the proposition will reduce to sum of AB and AC greater than half sum of AB, BC, and CA.

Taking from each half the sum of AB and AC, it follows that half the sum of AB and AC is greater than half AB, or sum of AB and AC is greater than AB, which is I. 20.

We add a few riders:—

1. If O be a point within a triangle ABC, prove that the perimeter of the triangle is greater than the sum of OA, OB, and OC.

2. Draw to scale a line of length $\sqrt{13}$ inches.

3. If ABC be a triangle right-angled at B, and BD be drawn perpendicular to AC, show that rectangle AD . AC = square on AB.

4. To describe a rhombus equal in area to a given triangle.

ARITHMETIC COURSE.

Read chapters xvi., xvii., and xviii. of Pendlebury.

Solutions to examples in our last course :—

1. To reduce $\frac{9}{19}$ to a decimal—

$$\begin{array}{r} 19)10\cdot0(\cdot5 \\ \underline{9\ 5} \\ 5 \end{array}$$

Now $\frac{5}{19}$ is $\frac{1}{2}$ of $\frac{10}{19}$, and the first figure of $\frac{10}{19}$ is ·5.

∴ the first figure of $\frac{5}{19}$ is ·2.

From the working above we see that the remaining figures of $\frac{10}{19}$ are the figures of $\frac{5}{19}$ (that is, ·2).

∴ the second figure of $\frac{10}{19}$ is 2.

∴ the first two figures of $\frac{10}{19}$ are ·52.

∴ the first two figures of $\frac{5}{19}$ are ·26.

∴ the first three figures of $\frac{10}{19}$ are ·526.

Proceeding thus mentally, we get $\frac{10}{19} = \cdot\dot{5}26315789473684210\dot{5}$.

2. $\cdot1\dot{3}\dot{4} = \frac{1}{8}\frac{3}{9}\frac{4}{9}$. For method see Art. 184 of Pendlebury.

3. ·038 or ·04 approximately.

4. 2 qrs. 21·47 lbs.

5. 76451, when divided by 9, gives the same remainder as 7 + 6 + 4 + 5 + 1 or 23 does—that is, a remainder of 5. 45167 being made of same digits, also gives a remainder 5. Hence their difference gives no remainder—that is, divides exactly by 9.

Examples :—

1. Find the lowest number which, when divided by 2, 3, 4, 5, 6, 7, 8, and 9, gives remainders 1, 2, 3, 4, 5, 6, 7, and 8 respectively.

2. Find (approximate method) to three decimal places the square of 1·732.

ALGEBRA COURSE.

Chapters xvii. and xviii. of Hall and Knight should be read and mastered. Factors are most important, and skill in factorising can only be obtained by working plenty of exercises. Every third example in these chapters should be worked.

Solutions and answers to examples in Course I. :—

1. $4x^4 - 12x^3 - 3x^2 + 18x + 9$.
$8x^3 - 36x^2y + 54xy^2 - 27y^3$.

2. $x = 2$, $y = 1$.

3. Let x, y, and z pounds be laid on the three men respectively.
Then, if the first man win, we gain $2x$£, and lose y£ and z£ on the other two men, so that $2x - y - z = 3\frac{1}{4}$. . . . . (1)
Similarly, $3y - x - z = 3\frac{1}{4}$. . . . . (2)
$4z - x - y = 3\frac{1}{4}$. . . . . (3)
Solving these in ordinary way, we get
$x = 5$, $y = 3\frac{1}{4}$, $z = 3$.

4. Since all squares are positive quantities, the sum of two squares can only be zero if each be separately zero.
$3x - y - 2 = 0$. . . . . (1)
$7x + y - 8 = 0$. . . . . (2)
Solving, we get $x = 1$, $y = 1$.

5. Let $x - 1$, x, $x + 1$, $x + 2$, be four consecutive integers. Then
$$\begin{aligned} &(x - 1)\,x(x + 1)\,(x + 2) + 1 \\ &= x(x^2 - 1)\,(x + 2) + 1 \\ &= x(x^3 + 2x^2 - x - 2) + 1 \\ &= x^4 + 2x^3 - x^2 - 2x + 1 \\ &= (x^2 + x - 1)^2, \end{aligned}$$
as may be found by the ordinary method of square root.

Examples :—

1. Factorise $x^6 - x^5 - x^4 - x$ and $x^6 - 1$.

2. If $a + b = x$, $a - b = y$, find $a^3 - b^3$ in terms of x and y, and hence find $5002^3 - 4998^3$.

GENERAL ELEMENTARY SCIENCE AND MECHANICS.

Loney's *Mechanics and Hydrostatics*. Chapters xiii. and i. and ii. are to be read, and plenty of examples worked.

In science (Briggs's *Elementary General Science*), chapters v., vi., and vii. of the Mechanics and chapter iii. of the Light.

1. Since the times of rising and falling are equal, and the stone takes 6 seconds to rise and fall, ∴ it takes 3 seconds to fall.
∴ it falls a distance $s = \frac{1}{2}gt^2 = \frac{1}{2} \times 16 \times 9 = 72$ feet, which is therefore the height it reached.

2. First, to find how long it takes to go 1 foot, we have

$$\left.\begin{array}{l} s = 1 \\ f = 18 \\ t = ? \end{array}\right\} \quad \begin{array}{l} s = \frac{1}{2}ft^2. \\ \therefore\ 1 = 9t^2. \\ \therefore\ t = \frac{1}{3} \text{ second.} \end{array}$$

Secondly, to find how long it takes to go 2 feet,
$$s = \tfrac{1}{2}gt^2.$$
$$\therefore\ 2 = 9t^2.$$
$$\therefore\ t = \frac{\sqrt{2}}{3}.$$

∴ the time taken over the second foot
$$= \frac{\sqrt{2}}{3} - \frac{1}{3} = \frac{\sqrt{2} - 1}{3} \text{ seconds.}$$

3. Here we have

$$\left.\begin{array}{l} u = -32 \\ g = 32 \\ t = ? \\ s = 4080 \end{array}\right\} \quad \begin{array}{l} s = ut + \frac{1}{2}gt^2. \\ 4080 = -32t + 16t^2. \\ \therefore\ t^2 - 2t - 255 = 0. \\ \therefore\ (t - 17)\,(t + 15) = 0. \end{array}$$

∴ $t = 17$, the negative answer, 15 not being applicable.

Note the u is − 32, while g is + 32—upwards being reckoned as negative, and downwards as positive.

4, 5, 6, and 7 are book work.

Questions and examples :—

1. From a balloon ascending uniformly at rate of 32 feet per second a stone is let fall, and reaches the ground in 17 seconds. Find the height of the balloon.

2. What force will stop a mass of 3 lbs., moving at rate of 20 feet per second, in (*a*) 2 seconds, (*b*) 2 feet ?

3. Find, without the use of any formula, the acceleration given to a mass of 100 lbs. by a force equal to the weight of 25 lbs.

4. Define a poundal and a dyne.

5. State the laws of refraction, and give experiments verifying them.

Illustrative examples :—

1. Compute the value of $\frac{1}{\sqrt{3} + 1} + \frac{1}{\sqrt{2} - 1}$ to two places of decimals. (June 1898.)

$$\frac{1}{\sqrt{3} + 1} = \frac{(\sqrt{3} - 1)}{(\sqrt{3} - 1)\,(\sqrt{3} + 1)} = \frac{\sqrt{3} - 1}{3 - 1} = \frac{1\cdot73}{2} = \cdot86.$$

$$\frac{1}{\sqrt{2} - 1} = \frac{\sqrt{2} + 1}{(\sqrt{2} + 1)\,(\sqrt{2} - 1)} = \sqrt{2} + 1 = 2\cdot41.$$

Note $\sqrt{3} = 1\cdot732$, $\sqrt{2} = 1\cdot414$. These values can be found by ordinary method of extracting roots, and are useful to remember.

2. Two men undertake to do a piece of work for £6. One of them could do it by himself in 16 days, while the other would require 20 days. They employ an assistant; and, all three working together, they complete the work in 8 days. How much of the money has each of them earned ?

Let A and B be the two men, and C their assistant.

Since A can do the work in 16 days, ∴ in 1 day A does $\frac{1}{16}$ of the work.

∴ in 8 days A does $\frac{1}{2}$ the work.

Similarly, in 1 day B does $\frac{1}{20}$ of the work.

∴ in 8 days B does $\frac{2}{5}$ of the work.

And as the work is finished in 8 days, C must do the remainder—namely, $1 - \frac{1}{2} - \frac{2}{5}$, or $\frac{1}{10}$ of the work.

Their pay of £6 must hence be divided in the ratio $\frac{1}{2} : \frac{2}{5} : \frac{1}{10}$, or 5 : 4 : 1—so that

A has $\frac{5}{10}$ of £6—that is, £3.
B has $\frac{4}{10}$ of £6—that is, £2, 8s.
C has $\frac{1}{10}$ of £6—that is, 12s.

3. Reduce to their simplest forms the expressions—

(i) $\left(\dfrac{x + y}{x - y} - \dfrac{x^3 + y^3}{x^3 - y^3}\right)\left(\dfrac{x}{y} + \dfrac{y}{x} + 1\right)$

(ii) $\dfrac{1}{(1 - a)\,(1 - b)} - \dfrac{a^2}{(1 - a)\,(a - b)} + \dfrac{b^2}{(1 - b)\,(a - b)}$

(June 1898.)

(i) $\left(\dfrac{x + y}{x - y} - \dfrac{x^3 + y^3}{x^3 - y^3}\right)\left(\dfrac{x}{y} + \dfrac{y}{x} + 1\right)$

$$= \frac{(x + y)\,(x^2 + xy + y^2) - (x^3 + y^3)}{(x - y)\,(x^2 + xy + y^2)} \times \frac{x^2 + y^2 + xy}{xy}$$

$$= \frac{2(x^2y + xy^2)}{(x - y)\,(x^2 + xy + y^2)} \times \frac{x^2 + xy + y^2}{xy}$$

$$= \frac{2xy(x + y)}{(x - y)\,(x^2 + xy + y^2)} \times \frac{x^2 + xy + y^2}{xy} = \frac{2(x + y)}{(x - y)}.$$

(ii) $\dfrac{1}{(1 - a)\,(1 - b)} - \dfrac{a^2}{(1 - a)\,(a - b)} + \dfrac{b^2}{(1 - b)\,(a - b)}$

$$= \frac{(a - b) - a^2(1 - b) + b^2(1 - a)}{(1 - a)\,(1 - b)\,(a - b)}$$

$$= \frac{a - b - a^2 + a^2b + b^2 - ab^2}{(1 - a)\,(1 - b)\,(a - b)}$$

$$= \frac{(a - b) - (a^2 - b^2) + a^2b - ab^2}{(1 - a)\,(1 - b)\,(a - b)}$$

$$= \frac{(a - b) - (a - b)\,(a + b) + ab(a - b)}{(1 - a)\,(1 - b)\,(a - b)}$$

$$= \frac{(a - b)\,(1 - a - b + ab)}{(1 - a)\,(1 - b)\,(a - b)} = \frac{(a - b)\,[1 - a - b(1 - a)]}{(1 - a)\,(1 - b)\,(a - b)}$$

$$= \frac{(a - b)\,(1 - a)\,(1 - b)}{(1 - a)\,(1 - b)\,(a - b)}$$

$$= 1.$$

THE L.L.A. OF ST. ANDREWS.

In the September number of THE PRACTICAL TEACHER it was announced that, provided a goodly number of requests were received, a course of preparation for the L.L.A. title and diploma would be made one of the features of our October number; and lady subscribers were invited to write to us, making known their wants and wishes in this particular. We have to thank those of our readers who responded to this invitation, and to express to them our sincere regret that the small number of requests received does not, unfortunately, warrant us in making the innovation, which we should have been happy to have undertaken had the number of applicants been much greater. In all, we have received forty-eight requests referring to about a dozen different subjects, the highest number of applicants for any particular subject being only twelve. Taking into consideration the many thousands of subscribers to THE PRACTICAL TEACHER, the response to our invitation cannot be regarded as anything other than disappointing. It is obviously impossible for us to undertake a course of preparation for which there is so little apparent demand; and if the demand is really greater than those four dozen letters would lead us to think, we trust that those of our readers who may feel disappointed will see that they have nobody but themselves to blame. It may interest L.L.A. candidates to know that the subject most in demand was Honours English, whereat we are not much surprised, as it is an exceedingly wide and difficult subject, including the study of no less than eleven different books, most of them bulky but by no means uninteresting tomes; indeed, a course in Honours English could have been made very helpful, not only to L.L.A. students, but to the lovers of the mother tongue in general, so that it is doubly to be regretted that there was not a more general response to our invitation.

We have been asked by a lady subscriber to say how the L.L.A. title and diploma compares in value with the London B.A. and other similar degrees of the various universities. In answer to this question, we may state that the London degree is certainly, and worthily, in higher esteem than the L.L.A., if only from the fact that a pass in the whole of the subjects must be obtained at one examination, failure in one subject necessitating re-examination in the whole of the subjects taken up. But the L.L.A. is without doubt of equal value—if not of greater—with any British university degree that may be taken piecemeal, especially if Honours be taken in one or two subjects; in fact, it gives the successful student the status of a university graduate.

In our January 1901 number we shall have pleasure in repeating our offer to undertake an L.L.A. preparation course in Honours English for the June 1902 examinations, provided always a sufficiently large number of our subscribers, whom it is our privilege to serve, express a desire that this should be done, the course to be started as soon as the 1902 syllabus shall be published, in order to give, if possible, more than a year to this interesting and useful subject. In the meantime, we again express our regret to those amongst our readers whom we are by the force of circumstances thus compelled to disappoint. We need hardly add that we shall be happy to do our best in our Query Column to smooth the special difficulties of any of our subscribers who may be preparing for the 1901 examination.

Ready Shortly.

CORNELIUS NEPOS:
LIVES OF MILTIADES AND EPAMINONDAS.

Text, Translation, Notes, etc.

With every possible help for

SCHOLARSHIP STUDENTS, 1901.

By C. J. Phillips, M.A.,

Latin Master, Stockwell Pupil Teachers' Centre.

THOS. NELSON AND SONS, 35 and 36 Paternoster Row, London, E.C.

QUERY COLUMN.

RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the name and address of the correspondent, and the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

E.S.—Try Young Collectors' Series (Sonnenschein), or apply Percy, Lund, and Co., Publishers, Amen Corner, Paternoster Row, E.C.

W.H.W.—Apply to Messrs. Blackie and Son, Chapman and Hall, or Moffatt and Paige. Each firm publishes what you require.

F. H. Hibbert.—The following are suitable novels to read with English history, 1066–1603:—*Harold* (Lytton), *Hereward the Wake* (Kingsley), *William the Conqueror* (C. J. Napier), *The Camp of Refuge* (C. Mackay), *Ivanhoe* and *The Talisman* (Scott), *Runnymede* and *Cressy and Poitiers* (J. E. Edgar), *John of Gaunt* (J. White), *Forest Days* (*Robin Hood*) and *Agincourt* (G. P. R. James), *The Caged Lion* (C. M. Yonge), *Joan of Arc* (Mark Twain), *Last of the Barons* (Lytton), *Windsor Castle* (Ainsworth), *Wolsey* (G. P. R. James), *Constable of the Tower* (Ainsworth), *The Monastery* and *The Abbot* (Scott), *The Royal Merchant* (Kingston), *Kenilworth* (Scott), *Westward Ho* (Kingsley), *Pictures of the Period* (Collier), *Hakluyt's Voyagers' Tales* (Cassell), *Westward with Columbus* (Gordon Stables), *Under Drake's Flag* (Henty). See also *Descriptive Catalogue of Historical Novels and Tales*, by H. C. Bowen (Stanford). The following books will be found useful for reference:—*English Seamen of the Sixteenth Century* (J. A. Froude), *Lives of Drake and Cavendish* (Blackie), *Davis the Navigator* (Markham).

A. W. B.—Give an equation which will represent any circle concentric with the circle

$$x^2 + y^2 + 4x + 6y + 8 = 0,$$

and find the equation to a circle concentric with this one, and touching the line $x = y$. (R.U.I., B.A.)

The equation can be written in the form

$$(x + 2)^2 + (y + 3)^2 = 2^2 + 3^2 - 8 = (\sqrt{5})^2,$$

which represents a circle whose radius is $\sqrt{5}$, and whose centre is the point $(-2, -3)$.

Instead of $\sqrt{5}$ put c; then

$$(x + 2)^2 + (y + 3)^2 = c^2$$

represents all circles concentric with the given one. In order that the circle may touch the line $x - y = 0$, its radius must be the length of the perpendicular from the point $(-2, -3)$ on to the line $x = y$; this is

$$\frac{-2 - (-3)}{\sqrt{1^2 + 1^2}}, \text{ or } \frac{1}{\sqrt{2}}.$$

The required equation is therefore

$$(x + 2)^2 + (y + 3)^2 = \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{2},$$

or $\quad 2x^2 + 8x + 2y^2 + 6y + 25 = 0.$

Dum Spiro Spero.—Two men, A and B, play at cards. If B wins 10 shillings, he then has three-quarters of what A has; but if, instead, A wins a sovereign, he then has four times as much as B has. Find how much money each starts with. (Lond. Matric., June 1900.)

Let A have x shillings, and B have y shillings, when they start. From the first statement given we get

$$y + 10 = \tfrac{3}{4}(x - 10) \quad . \quad . \quad . \quad . \quad (1)$$

From the second statement we get

$$x + 20 = 4(y - 20) \quad . \quad . \quad . \quad . \quad (2)$$

The two equations become

$$x - 4y = -100 \quad . \quad . \quad . \quad . \quad . \quad (1)$$
$$3x - 4y = 70 \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Subtracting, $\quad 2x = 170,$

$$x = 85.$$

Substituting this in equation (1), we find

$$y = 46\tfrac{1}{4}.$$

∴ A has £4, 5s., and B has £2, 6s. 3d., at the start.

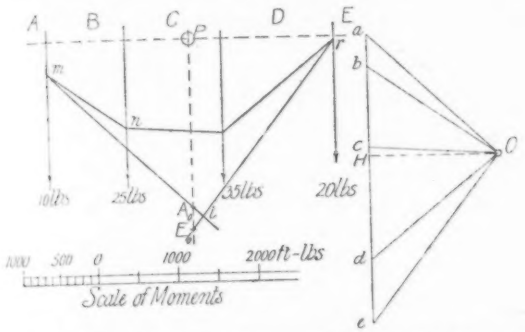
Ariadne.—Four parallel forces act round a point P. Find graphically, and write down in foot-pounds, their resultant moment; also draw a scale of moments. (Take by preference moment base or polar distance = 40 feet; scale of length, 15′ = 1″; scale of forces, 15 lbs. = 1″.)

(Practical Plane and Solid Geometry, S. and A., 1900.)

The rule only is given; a full explanation would require too much space.

Attach letters A, B, C, D, E between the forces, as shown; thus the force of 10 lbs. would be spoken of as the force AB.

Draw *ab*, *bc*, *cd*, and *de* parallel and equal (scale of 15 lbs. = 1″) to the forces AB, BC, CD, and DE.



Select the pole O anywhere. The examiners, however, for their own convenience, ask that O shall be so chosen that the polar distance OH is 40 feet to a scale of 15′ = 1″. Hence select O such that OH (drawn perpendicular to *ae*)

$$= \frac{40}{15} = 2\tfrac{2}{3}''.$$

Join O to *a*, *b*, *c*, *d*, *e*.

Across the space B—that is, between the lines of action of the forces 10 lbs. and 25 lbs.—draw a line parallel to O*b*. (This line is *mn*, and is spoken of as the *link* B.) Similarly, draw the links C and D parallel to O*c* and O*b*. The spaces denoted by A and E are not limited sideways like the spaces B, C, and D, but draw lines of indefinite length through *m* and *r* parallel to O*a* and O*e* respectively. (If we wanted the *resultant* of the four forces, it would act through O, and *mi* and *ri* must be regarded as the links A and E.)

Since we require the resultant moment of the four forces about P, the *rule* is to take the first and last letters used, A and E, and draw a line through K parallel to *ae*, to meet the links A and E in A_0 and E_0; then A_0E_0 measured on the force scale (which gives 6·92 lbs.), and multiplied by OH measured on the length scale (that is, 40 feet), gives the required moment, which is 6·92 lbs. × 40 feet, or 277 foot-pounds.

Observe that if A_0E_0 happened to be exactly 1″, then the moment would be 15 lbs. × 40 feet; hence the moment scale is 1″ = 15 × 40, or 600 foot-pounds.

In other words, instead of measuring the distance A_0E_0 on the force scale and multiplying by 40, we simply measure A_0E_0 on the scale of 1″ = 600, or $1\frac{2}{3}'' = 1000$ foot-pounds. This scale of moments is easily drawn, and is shown in the figure.

The figure was originally drawn full size, but it has been reduced about three times.

J. Cameron.—Divide 560 into two parts such that $\frac{1}{10}$ of one part added to $\frac{1}{2}$ of the other part shall be equal to 82.

$\frac{1}{10}$ of first part + $\frac{1}{2}$ of other part = 82.
$\frac{1}{10}$ (first part) + $\frac{1}{2}$ (560 − first part) = 82.
$\frac{1}{10}$ (first part) + 112 − $\frac{1}{2}$ (first part) = 82.
112 + ($\frac{1}{10}$ − $\frac{1}{2}$) first part = 82.
112 − $\frac{1}{10}$ of first part = 82.
∴ $\frac{1}{10}$ of first part must = 30,
and first part = 300,
other part = 260. } Ans.

Dum Spiro Spero.—A series of circles pass through two fixed points A, B. From C, a point on AB produced, tangents are drawn to the circles. Show that all the points of contact lie on a certain circle. (First Year Certificate, 1900.)

Take any one of the circles passing through A, B, and from C draw a tangent touching the circle at T.

Now, $CT^2 = CB.CA$ (III. 36).

But as both CB and CA are *fixed* lengths, their product is constant, and therefore CT is of constant length.

This is true for every circle in the series, therefore the points of contact of the tangents from C are all the same distance from C—that is, they lie on a circle with centre C.

Enquirer.—Find the envelope of $y = mx + am^p$, *m* being the arbitrary parameter.

To get the equation to the envelope, differentiate with respect to *m*, and then eliminate *m* from the resulting equation. Thus differentiating, we get

$$0 = x + pam^{p-1}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Multiply through this equation by *m*, and we get

$$0 = mx + pam^p.$$

Subtract from given equation, and we get

$$y = am^p(1 - p), \text{ or } m^p = \frac{y}{a(1-p)},$$

and $m = \left[\frac{y}{a(1-p)}\right]^{\frac{1}{p}}$, and therefore $m^{p-1} = \left[\frac{y}{a(1-p)}\right]^{\frac{p-1}{p}}$.

Substituting this in equation (1), we get

$$0 = x + pa\left[\frac{y}{a(1-p)}\right]^{\frac{p-1}{p}},$$

which, on simplification, gives us

$$(p-1)^{p-1}x^p + p^pay^{p-1} = 0. \quad \text{Ans.}$$

Enquirer.—Find the limiting values to which the following expressions approach:—

(*a*) $\frac{1}{xe^x} - \frac{1}{x}$, as x approaches zero.

(*b*) $\frac{\sin\frac{\pi x}{4} + \cos\frac{\pi x}{4} - \sqrt{2}}{(x-1)\log x}$, as x approaches unity.

(*a*) $\frac{1}{xe^x} - \frac{1}{x} = \frac{1}{x}\left(\frac{1}{e^x} - 1\right) = \frac{e^{\frac{1}{x}-1}}{x} = \frac{e^{-x} - 1}{x} = \frac{\theta(x)}{\phi(x)}$, say.

This is of the form $\frac{0}{0}$, and its limiting value may be found by the method of differentiation.

$\frac{\theta'(x)}{\phi'(x)} = \frac{-e^x}{1}$, which becomes -1 when $x = 0$.

The expression approaches -1 when x approaches zero. Ans.

(*b*) $\frac{\sin\frac{\pi x}{4} + \cos\frac{\pi x}{4} - \sqrt{2}}{(x-1)\log x} = \frac{\theta(x)}{\phi(x)}$, say.

The expression is of the form $\frac{0}{0}$ when $x = 1$.

$$\frac{\theta'(x)}{\phi'(x)} = \frac{\frac{\pi}{4}\cos\frac{\pi x}{4} - \frac{\pi}{4}\sin\frac{\pi x}{4}}{\frac{x-1}{x} + \log x}.$$

This is also of form $\frac{0}{0}$.

$$\frac{\theta''(x)}{\phi''(x)} = \frac{-\frac{\pi^2}{16}\sin\frac{\pi x}{4} - \frac{\pi^2}{16}\cos\frac{\pi x}{4}}{\frac{1}{x^2} + \frac{1}{x}}.$$

When x is unity, this becomes

$$\frac{-\frac{\pi^2}{16}\sqrt{2}}{2} = -\frac{\pi^2\sqrt{2}}{32}.$$

The given expression approaches $-\frac{\pi^2\sqrt{2}}{32}$ as x approaches unity.

Bene.—Prove that in the continued product $(1 + x + x^2 + \ldots\ldots + x^{2n})(1 - x + x^2 - \ldots\ldots + x^{2n})$ the coefficients of odd powers of x are zero, and of even powers unity.

(Cambridge Senior, 1888.)

The two factors are $\frac{1 - x^{2n+1}}{1 - x}$ and $\frac{1 + x^{2n+1}}{1 + x}$,

the product of which is $\frac{1 - x^{4n+2}}{1 - x^2}$,

which is $1 + x^2 + x^4 + \ldots\ldots + x^{4n}$.

Thus the coefficient of each even power is 1, and as there are no terms of odd powers, the coefficient of each is zero.

Xante, J. Carver, A. W. B. by post.

OUR SCIENCE SECTION

☛ **Subscribers requiring Explanations of Difficulties in any branch of Science, or Advice upon Courses of Study, can obtain all help required by communicating with the Editor, and accompanying their query with the Coupon cut from this Number.**

STAR STUDY

FOR SCHOLARSHIP STUDENTS.

XI.—OCTOBER.

THE **Zenith** shows Cygnus, or the Swan, whose T-shaped cluster of four bright stars will be found to the left of Vega the beautiful; Cepheus, the position of which is indicated by the two right-hand stars of his wife Cassiopeia, which forms the third asterism to be seen in the Zenith during our October evenings.

The **Northern** heavens display Ursa Minor; Draco, which may be seen winding his coils round the Pole Star; and Ursa Major, now well on the way to complete the circle round the Pole which he began in our company in December last. To the north-east of the horizon, Auriga the Charioteer is to be seen.

The **East** is resplendent with Cancer, Gemini, Aries, the Pleiades portion of Taurus, the second of the zodiacal constellations, in which also is to be found the V-shaped cluster the Hyades, near which is the first-magnitude star Aldebaran—the Bull's Eye. The six stars of the Pleiades visible to the naked eye should be made out, as should also the six Hyades, Andromeda, and Perseus, the latter with the wonderful variable star Algol, which changes from the second to the fourth magnitude in sixty-nine hours, and concerning which we have presently something more to say.

The **South** is bright with Pegasus the Winged Steed, Aquarius, Capricornus, and just above the horizon the first-magnitude star Fomalhaut, belonging to the asterism Piscis Australis, which is best found by prolonging the three right-hand stars of the constellation Cetus (the Whale) below Aquarius, when Fomalhaut will be reached just above the horizon. As it is only during the month of October that this southern constellation, with its beautiful cynosure Fomalhaut, is visible to dwellers in northern latitudes, the student should make the most of his present opportunity.

The **West** displays Lyra with the glorious Vega, its bright particular star, Hercules, Corona, Ophiuchus, and Sagittarius.

Planets.—Venus shines in the early dawn. On the 15th of the month she rises about four and a half hours before sunrise. During the month she is in the constellation Leo, and on the 19th will be found near to the moon.

Mars rises in the middle of October, about a quarter of an hour before midnight. He is in the constellation Cancer.

Mercury is in Libra, and is badly situated for observation until the end of the month.

Jupiter is lost in the twilight, as he sets shortly after the sun. He is in the constellation Ophiuchus, and is near the moon on the 27th inst.

Saturn is in Sagittarius, and is not well placed for observation, as he is only visible from sunset till about 8 p.m.

First-Magnitude Stars.—These we have over and over again mentioned in the course of our observations, and the time has now come when the student should finally commit to memory these most conspicuous of all the stars, so that he may have them at his fingers' ends, as it were, and be able to go over them, as far as the season permits, whenever he looks at the heavens. It is generally conceded that, of the five hundred million stars that Professor Lockyer tells us have been rendered visible by the photographic camera, **twenty** are entitled to rank as of the first magnitude—nine being northern and eleven southern constellation stars. Of the eleven first-magnitude stars belonging to the southern constellations, six never become visible in England, so that the student has to concern himself with fourteen only of these stars, which we give below in tabular form.

STAR MAP NO. XI. (OCTOBER).

It will be a useful exercise for the student to make a list of these stars, and to put opposite the name of each any particulars concerning them with which he becomes acquainted. For example, he should classify them as circumpolar or the reverse, and, with respect to those that are not circumpolar, he should carefully record the months during which they are above the horizon, and therefore visible in our latitudes. He should also classify them as belonging to (*a*) the northern, (*b*) the southern, or (*c*) the zodiacal groups of constellations. Another most important item is their polar distance—that is, their angular distance from the north or south pole. He should proceed to calculate what will be their greatest and what their least altitude, including their depression below the horizon. Finally he should draw diagrams showing the paths of these stars with respect to the plane of the equator and of the horizon. He will find, if he follows this suggestion, that his grip of astronomy will become stronger and stronger as he perseveres in this detailed study of

Constellation Name.	Popular Name.	Constellation Name.	Popular Name.
α Canis Majoris.	Sirius.	α Tauri.	Aldebaran.
		α Scorpii.	Antares.
α Boötis.	Arcturus.	α Aquilæ.	Altair.
β Orionis.	Rigel.	α Virginis.	Spica.
α Aurigæ.	Capella.	α Piscis Australis.	Fomalhaut.
α Lyræ.	Vega.		
α Canis Minoris.	Procyon.	β Geminorum.	Pollux.
		α Leonis.	Regulus.
α Orionis.	Betelguese.		

the first-magnitude stars; hence we again impress as strongly as we can upon our readers the wisdom of pursuing this series of observations.

Algol and other Variables.—Immediately below Cassiopeia is the constellation Perseus, of which we have previously spoken. This consists of a line of stars which branches off in two divergent curves, the one to the left, the other to the right. Just outside the right side limb two bright stars will be seen, the upper one being that of which we are in search. It is Algol, the Demon, as its name implies. This star the student is to observe closely with respect to his magnitude. He is to select two stars near Algol, one of which is fainter and one brighter than Algol—α Persei or γ Andromedæ will do very nicely—and to compare Algol with these stars at intervals of about an hour. He will find that Algol varies very materially during a period of nine hours, as already intimated. It is this variability in brightness that the observing powers of the student are to be exercised upon, and a careful record of what is seen should be kept. After Algol, o Ceti, δ Cephei, and β Lyræ should be subjected to the same process of observation, after which the student should turn to his text-book and study what is there written concerning variable stars; but the most important part of this study will be the naked-eye observation of the Demon.

NOTES ON PHYSIOLOGY.

ADVANCED AND HONOURS.

BY WALKER OVEREND, M.A., M.D. (OXON.), B.SC. (LONDON),

Late Senior Physician to the Tottenham Hospital; Radcliffe Fellow, Scholar of Balliol College, and Exhibitioner in Comparative Anatomy of the London University.

Special Senses.—A sensation, whether it be that of heat, sound, touch, is produced by the movement of molecules or masses in the world outside us; and the function of a sense organ is to receive these movements, and convert them into nerve impulses, which ascend along a sensory nerve towards the spinal cord and brain. In the latter they evoke changes, the result of which is that we become aware of a sensation of light, heat, or sound, as the case may be. It is more remarkable still, however, that we are able to *localise* the *stimulus* in many cases, and recognise the part of the body which is excited; also, we are able often to *project* the stimulus, and recognise it as proceeding from some object at a *distance* from us.

There is a certain relation between the strength of a stimulus and the reaction or sensation produced—that is, a stronger stimulus produces a greater sensation; but as the stimulus is increased, the amount of additional stimulus necessary to evoke an appreciable increase of sensation must also be increased. For instance, we can readily distinguish between the weight of 1 oz. and 2 oz., but we cannot distinguish between the weight of 39 lbs. and 39 lbs. 1 oz.; a whole pound must be added before a distinct difference is produced. This ratio in the muscular sense is 1 to 17; in that of pressure or tactile sense the ratio is 1 to 3.

Besides the five ordinarily recognised senses—sight, hearing, touch, smell, and taste—those of temperature, pain, and the muscular sense, or that of weight, must be mentioned.

Tactile sensation is the result of activity within the touch corpuscles in the skin and similar nerve-endings in the mucous membranes. It is divisible into those of (*a*) *pressure* and (*b*) *locality*. The increment of pressure (as already mentioned) necessary to be felt is $\frac{1}{3}$rd of the previous pressure. In testing this, all muscular movements must be avoided, in order that the muscular sense is not involved.

The sense of locality may be tested by measuring the distance at which two points of excitation must be apart in order to be felt as two. Any area in which two points *cannot* be distinguished as two may be called a sense circle. It varies in different regions. In the tongue it is 1 millimetre; finger-tip, 2; lips, 4; back of neck, 53; and in the middle of the back, 66 millimetres.

The Sense of Temperature.—When a body colder or hotter than the skin is placed upon it, a sensation of cold or heat is experienced. It is, however, difference of temperature only that we perceive. Thus to a hand previously placed in ice-cold water, water at 6° F. feels warm, but to a warm hand the latter feels cold. The sense is, therefore, relative. The cheeks, eyelids, and middle of the chest are particularly sensitive to changes of temperature. The hand is not the best gauge. Moreover, the sense of temperature is confined to very minute areas scattered over the skin. If a small metallic point (kept at the temperature of the body by passing a stream of warm water through it) be pressed gently over the skin at different points, it is found that certain points feel hot. By using a cool pencil a number of cold spots may be mapped out. The simplest explanation of the various senses possessed by the skin is to assume that the latter possesses several kinds of nerve fibres, each corresponding to a particular form of sensation. The sense of touch itself seems connected with the presence of *touch* corpuscles in the papillæ of the dermis, as the corpuscles are more numerous in the situations where the touch is most acute. These corpuscles are oval in shape, about $\frac{1}{100}$th of an inch long, and composed of connective tissue. The latter is prolonged inwards from the capsule, or outside covering, to form compartments in which are lodged granular masses containing nuclei. Nerve fibres coil round the outside of the corpuscle and pierce the capsule. The axis cylinders appear to end in small knobs.

Our imagination places the act of sensation in the skin itself, although, as a matter of fact, it lies in the brain. We cannot separate the sensation from the part irritated. This refers to all sensory nerves, and is termed the *law of peripheral perception*. We can explain it by assuming that our perceptive faculty is formed entirely by experience. The brain has in this way built up a complete picture of the surface of the body—a picture which is always being more highly perfected. If a triangular piece of skin from the forehead be detached and turned down over the nose (as is occasionally done by surgeons when the nose has been destroyed by disease) and stitched there, the new nose unites; but if it be pricked with a needle, the person for some time feels the prick on the forehead.

Stimulation of a sensory nerve trunk itself gives rise to general sensations only; nothing distinctly tactile is perceived. If the elbow be placed in hot water, warmth is felt in the elbow itself; but if the water be too hot, pain is felt. The ulnar nerve at the bend of the elbow is irritated by the heat, but the latter causes a sensation not of warmth but of pain.

Sensory Nerves of Muscles. Theories relating to the perception of Bodily Movements.—1. If we place the hand and arm flat upon a table, we can estimate the pressure exerted by bodies resting on the palm, and so form some judgment as to their weight. If we hold the body in the hand, we not only feel the pressure, but we are aware of the muscular exertion required to support and lift the body. We are thus conscious of a *muscular sense* which aids the sensations of pressure in coming to a judgment as to the weight of the object. This muscular sense is finer than that of pressure, as we can distinguish by it weights in the ratio of 17 to 18. It is obvious that the muscular sense must be largely assisted by the senses of pressure and sight.

2. According to Wundt and Bain, we are largely guided in our movements by the sensations felt in the centres themselves. In other words, the changes in the central nervous system involved in carrying out movements so affect our consciousness that we have a sense of the effort itself. Our consciousness judges of the voluntary impulses (or will) which are imparted to the motor nerves, and of the effects which follow. This view is supported by the assumption that (*a*) muscles possess no sensory nerves, and (*b*) we continue to possess this sense in certain cases of paralysis, as locomotor ataxy, when the skin is void of sensation. With regard to the first assumption, the investigation of Sachs (1874) showed that afferent nerves occur in the muscles (as the sartorius of the frog), and these pass to the outer surface of the sarcolemma, forming a network around the muscular fibres. Moreover, when muscles are inflamed, they are painful; also, after great exertion there is a *feeling* of fatigue within the muscles. On the other hand, if the existence of sensory fibres be granted, do these fibres explain to us the *state* of activity of the muscles?

3. Seeing that muscles possess little or no general sensibility—comparatively little pain being felt when the muscles are cut—it has been suggested that our muscular sense may be derived from the excitation of nerves which lie in the skin or membranes covering the muscle, or from the traction of the muscle on its attachments. Undoubtedly, in cramp, when the pain can be localised, it is often felt at the joints.

4. Since Sachs demonstrated the existence of sensory nerves within muscles, it has been assumed that these give us information about the changes in tension, pressure, and possibly also of the state of contraction in the muscle. Many phenomena, as the co-ordination of complicated movements, must depend on the presence of sensory fibres, since these movements become defective when the posterior roots are diseased. We must conclude that our muscular sense is, to a certain extent, *peripheral* as well as *central*. Meynert supposed the centre for muscular sensibility was situated in the motor cortical centres which lie round the fissure of Rolando, the muscles being connected with the ganglion cells of this region by motor and sensory paths.

CHEMISTRY NOTES.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),
First Class Honoursman in Chemistry.

The Boiling Points of Zn and Cd.—M. Berthelot, the great French chemist, has recently concluded the determination of the boiling points of these two volatile metals, which he boiled in an electric furnace specially constructed to avoid the errors due to superheating and radiation from the walls, the temperature being measured by the interference refractometer method. M. Berthelot gives the boiling point of zinc as 920° C., that of cadmium being 778° C.

Iodine in the Human Body.—MM. Bourcet and Gley have shown that there is a trace of iodine in the blood, and have, further, determined the amount of this element in various parts of the body. The quantities vary from nothing in fat, pancreas, and bladder, to 0·18 mgr. per 100 grams of liver, and 1·8 mgr. per 100 grams of hair. The quantities found elsewhere are small compared with the amount present in the thyroid gland. About 1·33 mgr. of iodine is taken into the human system daily as food; the thyroid gland contains only about 4 mgr.: hence it becomes necessary to discover the means of elimination. This is shown to be chiefly effected in man by the skin and epidermal products—sweat, skin, hair, and nails; in woman, by the menstrual blood, which contains 0·8 to 0·9 mgr. of iodine per kilogram, as against 0·2 mgr. per kilogram in normal blood.

New Method for the Separation of Chlorine and Iodine.—This method, which is due to Herrn Vanino and Hauser, depends upon the fact that, when we submit halogen derivatives of silver to the influence of alkaline solutions of formic aldehyde, the resistance to reduction increases very rapidly from the chloride to the iodide. The following is the *modus operandi*:—The haloid salts are precipitated by means of silver nitrate, filtered by decantation, and washed with boiling water, taking the necessary precautions to avoid carrying over the least trace of any solid substance. When the washing is complete, the precipitate is treated with 25 c.c. of a solution of 50 grams of carbonate of potassium in 100 grams of water, and 5 c.c. of 42 per cent. formic aldehyde. This is left to stand for some time at the ordinary temperature, and then heated to 30°–40° for half an hour. As for the particles adhering to the filter, which may have been accidentally carried over during the decantation, they are also moistened with a few c.c. of the warm mixture of alkaline carbonate and formic aldehyde. By means of this treatment, the chloride of silver is converted into metallic silver, while the iodide of silver is not changed. The liquid is again separated by decantation, and the solid portion which remains at the bottom of the beaker is taken up with warm nitric acid. If we then filter down again, we separate the insoluble iodide of silver from the metallic silver resulting from the reduction of the chloride, and which goes into solution in the dilute nitric acid. There now only remains, to complete the quantitative exercise, to weigh the iodide remaining on the filter, and to precipitate the silver contained in the filtrate by means of hydrochloric acid.

The Borides of Silicon.—MM. Moissan and Stock give the following account of these preparations:—Boron and silicon combine directly at a high temperature, producing two crystalline borides of formulæ SiB_3, SiB_6. These two new compounds are soluble in melted silicon, from which they may be separated by treatment with hydrofluoric and nitric acids. The crystals are very hard, easily scratching ruby. They resist the action of most reagents, but the compound SiB_3 is more easily attacked by potash, whilst SiB_6 is more easily decomposed by concentrated nitric acid. It is curious to compare this simultaneous formation of the two silicon borides with that of the two calcium borides, which are formed in a somewhat similar manner by the action of boron on carbon.

Amalgams of Sodium and Potassium.—When sodium is dissolved in mercury, and the mercury slowly cooled, beautiful crystals of the amalgam separate out. These are of the cubic form, and correspond to the formula $NaHg_8$. If, instead of extracting the crystals from the mercury, the mass is compressed in leather by hand, still the same amalgam remains; the liquid part, which is filtered off, is mercury saturated with sodium at the temperature of the experiment. This result is attributed to the fact of the compound $NaHg_8$ being a mixture of the amalgams Hg_8Na and Hg_2Na, the latter amalgam having been obtained in pure form. Furthermore, the existence has been shown of four distinct amalgams—namely, Hg_2Na, Hg_8Na, Hg_5Na, Hg_4Na. Substituting potassium for sodium, similar but not quite so well-defined results are obtained.

Combination of Nickel Sulphate with NH_2OH.—When anhydrous hydroxylamine is added to a cold solution of $NiSO_4$, the green colour of this salt gives place to an azure blue, and finally to a deep red tint. The solution then slowly (or rapidly upon the addition of a little alcohol) deposits red crystals, probably quadratic, of the salt $NiSO_4 + 6NH_2OH$ (instead of $6H_2O$), which consists of the hydrated crystals. These crystals are decomposed by water and by alcohol, with the separation of a white powder which has not yet been examined. On heating the red salt it swells up and changes colour, becoming successively blue and green. The blue salt, without doubt, contains less hydroxylamine.

New Use for Sodium Peroxide.—The usual method of purifying the bottoms of disused wells, in order to make it possible to descend them, is by the use of milk of lime. There is, however, this serious disadvantage in connection with this mode of procedure: the carbon dioxide contains all, or nearly all, the oxygen that was in the air before the carbon dioxide was formed; hence, upon the absorption of this compound, the nitrogen is left behind without any admixture of oxygen, so that there is no gain so far as suitability for respiration is concerned. It is suggested that sodium peroxide should replace the milk of lime in the purification, which would ensure the evolution of a quantity of oxygen for every molecule of carbon dioxide absorbed, as is shown by the following equation:—

$$Na_2O_2 + CO_2 = Na_2CO_3 + O.$$

Water Gas.—The opposition to the use of water gas by the gas companies of the United States has altogether vanished in consequence of the degree of purity to which the product has been brought. The Health Department of New York has, after careful inquiry, decided that the gas is such an improvement in quality and in price, whilst the increased danger in comparison with coal gas is so slight, that the production of water gas should not be interfered with; so that now there are at least five hundred gas companies using water gas either wholly or in part, and it is estimated that during 1899 no less than 52,500 million cubic feet of carburetted water gas was used for illumination purposes. The equation for the preparation of water gas is, as most of our readers already know—

$$H_2O + C = CO + H_2.$$

Hydrogen a Constituent of Pure Air.—M. Gautier has come to the conclusion, after much research, that hydrogen is an ingredient in normal air. The quantity present is, as might be divined, infinitesimal, M. Gautier's figures being two parts in ten thousand parts—that is, about half the volume of the carbon dioxide. To this should be added other combustible gases due to the exhalations and fermentations of the soil, vegetables, animals, or human industries, and consisting of hydrogens. This latter portion is naturally relatively large in towns, small in country districts, very slight on rocky plateaus and peaks of high mountains, and practically absent in the higher regions of the atmosphere. The exact nature of these hydrocarbons has not yet been determined.

Use of CaC_2 in Metallurgy.—The large quantities of carbide of calcium that are being produced by the action of carbon on lime in the electrolytic furnace render it desirable to find other uses for the compound besides the preparation of acetylene from water, hence it is suggested that the carbide may be used in the reduction of metallic ores, concerning which the following observations are made in the *Revue Générale des Sciences*:—Carbide of calcium is a deoxidising agent; if, therefore, to a metal in the state of fusion, which is always slightly oxidised, carbide of calcium is added, either alone or with quicklime, the general reaction would be as follows:—

$$CaC_2 + 2MO = 2CO + Ca + 2M.$$

It is evident that under these conditions, as one part only of the CaC_2 takes part in the reaction, the utilisation of the carbide would not be great. To increase its power, a metallic chloride, RCl, must be added, the chlorine of which will combine with the Ca set at liberty in such a manner that the two affinities of the C + O and of the C + 2Cl will act simultaneously:—

$$RCl + 2MO + CaC_2 = R + 2M + CaCl_2 + 2CO_2.$$

These conditions may be applied either to the extraction of a metal from its ores, or for the manufacture of metallic alloys, according as the metallic chloride taken corresponds with the metal to be extracted or not.

If M = R, we obtain the metal only; if not, we obtain the alloy R + 2M. We may quote as an example of the last formula the preparation of aluminium bronze, which consists of gently heating a mixture of alumina and chloride of copper in contact with carbide of calcium.

NOTES ON ADVANCED AND HONOURS PHYSIOGRAPHY.

Capella a Double Star.—Mr. W. H. M. Christie has, by direct observation with the large Greenwich equatorial, confirmed the opinion expressed by Campbell and Newall, and founded upon spectroscopic observations, that Capella, the cynosure of the constellation Auriga, is a double star. The star appears distinctly elongated in one direction, the distance of the two components being estimated at 0·1 second. Observations of the direction of this elongation, taken between April 4 and July 20, confirm the period of revolution deduced spectroscopically by Newall.

Lithothamnion Reefs.—In the East Indian Archipelago the *Siboga* party came across unexpected quantities of calcareous algæ, the Lithothamnion, the reefs formed by them being of considerable size at depths of 3 to 40 metres, and in one case even at 120 metres. Different circumstances of level, current, and other conditions must have co-operated to render the occurrence of Lithothamnion possible in such quantities; the expedition found them realised in at least thirty different localities, so that, for the future, the possible contribution of Lithothamnion remains to the formation of the earth's crust will have to be taken into consideration by geologists.

Submarine Disturbance.—The magistrate resident at Walfisch Bay, South Africa, reports the occurrence of a submarine disturbance of a very interesting character on May 31, when a new island 150 feet long by 30 feet broad, and standing 12 feet above high water, appeared, about 100 yards to the north-east of Pelican Point. The island was composed of a tenacious clay, and soundings showed a depth of from 7 to 10 fathoms around it. Steam was observed rising from the clay, and an intense smell of sulphuretted hydrogen was perceptible even at a distance of five miles.

Kite Meteorology.—A new record in the height reached by meteorological kites has just been established. On July 19 a line of six kites reached an altitude of 15,900 feet, or 3 miles and 60 feet above the sea-level, which exceeds the highest point ever reached in America by a balloon used for scientific purposes. Professor Hazen of the United States Weather Bureau obtained observations in a balloon at a height of 15,400 feet, in an ascent from St. Louis in June 1887, which is the highest ascent in America from which observations have been published. Four and three-quarter miles of piano wire were used at Blue Hill on the occasion of the experiment referred to above. The instruments attached to the kites showed freezing temperature at the highest point reached, and a north-west wind blowing with a velocity of twenty-six miles an hour. The air was found to be exceedingly dry.

New Siderite in Australia.—Mr. R. T. Baker contributed to the Royal Society an interesting account of a meteorite that has just been discovered in New South Wales. The meteorite described in the paper was found in January last, two miles from Bugaldi, a postal town fifteen miles north-west of Coonabarabran. It is pear-shaped, the broad part being 3 inches across, whilst in length it is some 5 inches. It is a siderite, its chief component elements being iron and nickel. It has a well-defined closely-adhering "skin" of black magnetic material, while the metal immediately below this coating is silvery-white in appearance. On the smooth portion, at the extremity of the larger end, the characteristic Widmanstätten figures are distinctly visible. The specimen has an exceedingly new appearance, as if it had only just fallen upon the earth, signs of oxidation being entirely absent. Another meteoric fall worthy of mention is described in a Reuter's telegram from Madrid of August 24, which states that twelve fragments of a meteorite fell in the boundary of the provinces of Jaen, Cordova, and Granada, the fall being preceded by a series of loud detonations. The meteorite broke into twelve fragments, one of which, weighing about 1 lb., was picked up at Val, in the province of Jaen. This fragment was hexagonal in shape, grey on the outside, and of a greenish colour within.

High Temperatures.—*La Nature*, in its issue for August 18, records the fact that, at the meteorological station at Châteaudun, near Paris, a temperature of 103°·6 in the screen was observed on July 27. The nearest approach to this high reading in the vicinity of Paris during the last hundred years was 101°·5, at Montsouris Observatory, on July 20; but at Poitiers, in July 1870, a reading of 106°·2 was recorded. Comparing London with Paris, it may be remembered that on July 16, 1899, a temperature of 95°·2 was recorded at Mr. Symons' station in Camden Town, whilst 97°·1 was recorded at Greenwich in July 1881, in which month a reading of 101° was obtained at Alton in Hampshire.

Globe Lightning.—Professor Toepler gives the results of his study of this phenomenon in *Annalen der Physik* for August. From a comparison of all the published records of the occurrence of globe lightning, the professor concludes that the globe is a form of continuous atmospheric discharge similar to the brush arc discharge of the laboratory. A lightning flash leaves behind it a track of heated and possibly ionised air, along which a slow, continuous discharge passes for some time after the flash. When this continuous discharge is strong enough, any part of the track which has an exceptionally high resistance may be made to glow, and the glow may continue for several seconds, or even for half a minute. The track may be blown aside by the wind, or driven by electrostatic forces, and then the globe will be seen to wander as is usually described. It often finishes with another lightning flash, and the thunderclap following that is described as an "explosion" of the ball. Considering the size and duration of the ball, Professor Toepler estimates its current strength at something between two and twenty ampères. As a lightning flash often carries 10,000 ampères, the destructive power possessed by globular lightning is very inconsiderable.

Zodiacal Light.—This phenomenon, which was discovered by Brorsen about the middle of this century, and systematically observed by Barnard, who determined both its shape and its position, has been the subject of a mathematical analysis by Mr. Moulton, on the supposition that it is due to a more or less condensed region of meteorites. Professor Barnard comes to the conclusion that the zodiacal light is always exactly opposite the sun, an opinion which is accepted by most astronomers, notwithstanding the divergent views of a few other observers. Taking this as correct, Mr. Moulton, after citing the well-known reasons for regarding interplanetary space as densely filled with meteoric particles, moving with widely varying velocities in all directions, supposes that a great multitude will at any time be situated at the opposition point, and that a considerable portion of these will be under such initial conditions as to remain there for some time. Then the meteors, being very small compared with the earth, are treated as infinitesimal bodies, disturbing neither the earth nor each other. He also neglects the eccentricity of the earth's orbit. Then referring the motion of one meteor to rectangular axes with the origin at the centre of gravity of the sun and the earth, he traces the conditions for stability for a certain time. Then, by slightly varying the conditions, he finds the nature of the movement of the infinitesimal body, with special reference to the circumstances under which it will make periodic oscillations round certain points. The result of successive integration suggests that meteors passing near one of these selected points with the assumed conditions of motion would be subject to forces directed nearly to this point, and would have a tendency to revolve round it. Although after a few revolutions they might escape, the average result would be a condensation with respect to space, if not with respect to time. The difficult point now to determine is whether a sufficient number would be captured to become visible. If the meteors are revolving round the sun at a distance of about nine hundred thousand miles greater than the earth's mean distance, they will be moving slower than the earth, which will gradually overtake them in longitude. As they approach opposition they will be retarded and drawn in towards the sun, their motion being thereby accelerated. The net results of these actions will be to bring the meteors into the plane of the ecliptic, thus causing the condensation at opposition, and explaining the tendency to an oscillation in latitude which has been observed.

Instead of being exactly opposite the earth, the point of condensation will be nearly opposite the centre of gravity of the earth and moon, and consequently the zodiacal light should have a monthly oscillation in latitude of the nature indicated by the observations of Douglass, but much less in extent. The oscillation in longitude would, however, be monthly also, instead of yearly, as the observations tend to indicate.

A phenomenon, observed so far by Barnard alone, is the series of marked changes to which the zodiacal light is subjected in short periods of time, being large and round in September and the beginning of October, becoming slightly elongated by the 4th or 5th, very much elongated by the 10th or 11th, and showing merely as a swelling on the zodiacal band by the 18th. Although this is not directly explicable, the shape of the zodiacal light will depend on the thickness of the zodiacal disc of meteorites; and if the opposition point should pass through a dense portion of the swarm, it is readily conceivable that a change of form would ensue. The distance of the opposition point works out at 930·240 miles from the earth. The period of oscillation would be 183·304 days. It is thus suggested as possible that meteors may move for long periods of time in the vicinity of the opposition point in sufficient numbers to cause the faint glow of the zodiacal light by reflecting the light of the sun.

MATHEMATICS.

STAGES 2 AND 3, BOARD OF EDUCATION, SOUTH KENSINGTON.

BY G. A. BAXANDALL,

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Stage 2.

Algebra.

To be able to simplify expressions constitutes quite one half of the work in nearly every portion of the subjects of algebra and trigonometry. Many of the rules and processes which have to be applied in dealing with the various portions of the subject are in themselves very simple and easily learned, but in carrying them out difficulties and mistakes occur in reducing or simplifying the expressions which arise. These cause loss of time and interest, and tend to dishearten the student, thus retarding any real progress. It is the student who can work *accurately* who makes most progress.

Hence it is absolutely essential that one should have constant practice in simplifying expressions.

A short time should be given to several portions of the subject which really belong to the elementary stage, such as the solution of simultaneous equations of the first degree, resolution of expressions into factors, the squaring and cubing of expressions. The student is supposed to be already very familiar with such relations as :—

$$x^2 - y^2 = (x + y)(x - y).$$
$$x^3 + y^3 = (x + y)(x^2 - xy + y^2).$$
$$x^3 - y^3 = (x - y)(x^2 + xy + y^2).$$
$$(x \pm y)^2 = x^2 \pm 2xy + y^2.$$
$$(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2xz + 2yz.$$
$$(x \pm y)^3 = x^3 \pm 3x^2y + 3xy^2 \pm y^3.$$

In order to carry out such revision as we have above referred to, we ask the reader to select and work out examples from the following sets :—

Hall and Knight's, Ex. xvii., *a* to *l* ; xxii., *c* ; xxiii., *b* and *c* ; xxiv.

C. Smith's, xvii. to xxi. ; xxviii. to xxxiv. ; xiii. to xv. ; xvi.

Todhunter and Loney's, xxvi. to xxxv. ; lii. and liii. ; lviii. ; lx.

Trigonometry.

Learn the definitions of a *degree* and *radian*, and the relation between them—namely, that a radian = 57·29 degrees (nearly).

Carry in your mind the size of a radian, so that if you were to see an angle drawn on paper you would be able to make a rough guess at the number of radians it contained.

Learn the definitions of the six trigonometrical ratios—sine, cosine, tangent, cosecant, secant, cotangent.

Understand that you can make no progress in trigonometry until you know these definitions as well as you know your alphabet. You may accomplish this by working examples like the following :—

Examples.—1. Draw an angle A, of say 37°, on paper, by means of a protractor. Take a point B in one of the lines bounding the angle, and some four or five inches from A, and draw BC perpendicular to the other bounding line. Measure carefully the sides of the right-angled triangle, and by actual division calculate the values of the six ratios for an angle of 37°. See how nearly your answers agree with the values given in the book of tables, Bottomley's or Chambers's, as recommended last month.

2. Work Ex. vi., 5 to 13, in Loney's *Trigonometry* ; Hall and Knight's, Ex. ii. ; iii. *c*, omitting 7 to 11 ; Hamblin Smith's, Ex. xviii. ; Lock's, Ex. xvii.

3. If the angles A, B, C of a triangle are 30°, 60°, and 90° respectively, it is easy to show that the opposite sides are in the ratio of 1, $\sqrt{3}$, 2. Attach these numbers to the sides, and write down the values of the six trigonometrical values for the angles 30° and 60°. The answers are to be found in Hall and Knight, p. 25 ; Loney, p. 37 ; Lock, p. 54 ; H. Smith, pp. 47, 48.

4. Find the trigonometrical ratios for an angle of 45°.

Logarithms.

The object in using logarithms is to reduce the labour when making ordinary arithmetical calculations.

There are some curious notions regarding the exact stage at which logarithms should be introduced into a course of mathematics. Undoubtedly many students first become acquainted with the use of logarithms when studying the solution of triangles in trigonometry, or in working certain money problems generally found in text-books of algebra. Such students often obtain wrong notions about the use of logarithms. When a person discovers that he has to make many numerical calculations, then is the time to take up the study of logarithms. No knowledge of algebra is really necessary, although the rules are generally to be found in text-books of algebra.

Now we have already recommended certain mathematical tables ; Chambers's book of tables contains an explanation of the rules, while Bottomley's does not. We leave the student to work up these rules for himself, as he is quite capable of doing this, especially with the help of chap. xli. in Todhunter and Loney's *Algebra*, or chap. xxxix. in Hall and Knight.

Geometry.

From the nature of the work which has to be done in Euclid, it will be obvious that very little help can be given in these brief notes. The propositions of Books II., III., and IV. have to be studied, and exercises have to be worked ; we shall occasionally give a few of the latter, and refer to certain useful "riders." During the next month the propositions of Book II. may be studied.

Stage 3.

Algebra.

The syllabus for this section consists of "permutations and combinations ; progressions ; complete theory of indices ; the binomial theorem."

There are, however, several other portions of the subject which the student will have to work at, such as the theory of quadratic equations, solution of simultaneous quadratic equations, determination of the maxima and minima values of expressions. These are dealt with in the following articles :—

Hall and Knight's *Higher Algebra*, Arts. 129 to 137, chap. ix.

Todhunter and Loney's, chap. xxv., chap. xxxi., and Art. 525.

C. Smith's *Treatise on Algebra*, Arts. 147 to 151, chap. ix.

Intermediate Algebra, Briggs and Bryan, Arts. 110, 111, 112, 118, 119, 123, 124, 127, 129, 130, 135, 136, chaps. xii. and xiii.

Examples should be worked from the sets provided in the above articles and chapters.

Work the following examples :—

1. Solve the equations—

$$x(y + z) = 36 ; \; y(z + x) = 50 ; \; z(x + y) = 56.$$

Ans. $x = \pm 3 ; \; y = \pm 5 ; \; z = \pm 7.$

2. Solve the equations—

(*a*) $x + \frac{1}{y} = a ; \; y + \frac{1}{x} = b.$

(*b*) $x^2 + y^2 - x - y = 48 ; \; x + y + xy = 31.$ (1899.)

Ans. (*a*) $x = \frac{1}{2}\left\{a \pm \sqrt{\frac{a}{b}(ab - 4)}\right\}$;

$$y = \frac{1}{2}\left\{b \pm \sqrt{\frac{b}{a}(ab - 4)}\right\}.$$

(*b*) $x = 7, 3, \frac{1}{2}\left\{-11 \pm \sqrt{-47}\right\}$;

$$y = 3, 7, \frac{1}{2}\left\{-11 \pm \sqrt{-47}\right\}.$$

3. If α and β be the roots of $ax^2 + bx + c = 0$, find the equation whose roots are $\alpha^2 + \beta^2$ and $(\alpha + \beta)^2$.

Ans. $a^4x^2 - 2a^2x(b^2 - ac) + b^2(b^2 - 2ac) = 0.$

4. Find the quadratic equation (or equations) which have the sum of the squares of the roots equal to − 24, and the sum of the reciprocals of the roots equal to $\frac{1}{3}$. (1900.)

Ans. $x^2 - 6x + 30 = 0 ; \; x^2 - 4x + 20 = 0.$

Trigonometry.

The next month (indeed, we might say the next three months) should be devoted to a consideration of the formulæ for finding the sine, cosine, and tangent of the sum and difference of two angles, and of the multiples and submultiples of an angle.

This section contains the most important formulæ in trigonometry, and the student will do well to work as many examples bearing on this section as he can find time for.

Read chaps. xi. and xii. Hall and Knight, or Arts. 88 to 108 in Loney.

In studying the above formulæ, it is not wise to always think of the A and B contained therein. Letters are necessary, but their use involves the danger of sometimes hiding the true meaning of the formulæ. As a safeguard against this danger, the student should try to acquire the habit of putting all

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formulæ into words, so as to express the real meaning. Thus, instead of learning that

$$\sin 2A = 2 \sin A \cdot \cos A,$$

we might just as well learn either that

$$\sin 12A = 2 \sin 6A \cdot \cos 6A,$$

$$\text{or } \sin \frac{A}{10} = 2 \sin \frac{A}{20} \cdot \cos \frac{A}{20}.$$

It is safer to learn it in the form

$$\sin (\text{any angle}) = 2 \sin (\tfrac{1}{2} \text{ angle}) \cdot \cos (\tfrac{1}{2} \text{ angle}).$$

Geometry.

The remarks under this head in the notes on Stage 2 apply also to Stage 3. The propositions of Book VI. have to be read, and with these the student should at once proceed.

NOTES ON THEORETICAL MECHANICS.

BY F. CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mechanics, Geometry, etc., Morley College, London; Author of "Elementary Practical Physics," etc.

ADVANCED AND HONOURS STAGES.

It will be found on reference to the Syllabus of Theoretical Mechanics, or to examination papers, that in the two sections—"Solids" and "Fluids"—into which the subject is divided, certain portions of statics and dynamics included in the former are also to be found in the latter, and it may therefore be advisable to briefly consider these at the outset.

Units.—The student should be familiar with the definitions of the units used in measurement—these may be obtained from any text-book—but some practice is necessary before any progress can be made, or the magnitude of a quantity can be indicated with any approach to accuracy.

In the F.P.S. system the units of *length*, *force*, and *time* are the *foot*, the *poundal*, and the *second*; and in the C.G.S. system the *centimetre*, *gram*, and *second*: these, and more especially the former, are of the utmost importance. Any reasonable time spent in getting clear ideas will greatly facilitate future progress.

In addition to the above, it is also necessary in some cases to use what are called the gravitational or engineer's units, in which the units are the foot, pound, and second respectively.

Thus when from a statical or dynamical problem the magnitude of a force is obtained, there should be no hesitation in deciding whether it is expressed in poundals or in pounds; and in a similar manner in foot poundals or foot pounds, from a work or energy problem.

Scalar and Vector Quantities.—In mechanics, what are called scalar and vector quantities are of frequent occurrence. In a scalar quantity it is necessary to know its *position* and *magnitude*; when these are known, the sum or difference of any number of scalar quantities can be obtained by simply adding or subtracting the separate magnitudes. Examples of scalar quantities are furnished by *weights*, *masses*, etc.

The above simple methods are not applicable to vector quantities, such as forces, accelerations, velocities, etc.; in these the specification must include not only *position* and *magnitude*, but also *direction*. The sum (or, better, the resultant) of two or more vectors cannot, except in a few special cases (referred to later), be obtained by simply adding the magnitudes. The sum is found by using a parallelogram, a triangle, or a polygon.

As an example, let two forces, of 10 and 15 units respectively, act at a given point. Then if the two forces act not only in the same straight line, but also in the same direction, the sum or resultant is $10 + 15 = 25$ units.

If the two forces act in the same straight line, but in opposite directions, the resultant is the difference of the two magnitudes, and is ± 5: the larger force may be either positive or negative, and it is necessary to use the double sign. When the directions or lines of action of the two forces make an angle with each other, the resultant, as already described, cannot be obtained by the simple process of addition or subtraction.

As an example, let the angle between the lines of action of the two forces be 60°; then the resultant may be obtained either graphically or by calculation. To obtain the resultant by the former method, we may proceed as follows:—

Using any convenient scale for the purpose, from any convenient point O draw a line equal in length to 15 units, and to the same scale make another line 10 units in length, and making an angle of 60° with the former. If the parallelogram be completed by drawing from the extremity of the second line a line parallel to the first, and from the extremity of the first a line parallel to the second, then the magnitude and direction of the resultant are indicated by that diagonal of the parallelogram which passes through point O; this, when measured, will be found to be 21·8 units. If the direction of the larger force be reversed, the resultant will be found to be 13·2 units.

By calculation, let R denote the resultant, and P and Q the two given forces. Then,

$$R^2 = P^2 + Q^2 + 2PQ \cos 60°.$$

$$\therefore R = \sqrt{10^2 + 15^2 + 2 \times 10 \times 15 \cos 60°} = \sqrt{475} = 21{\cdot}794.$$

When the direction of the larger force is reversed, the angle between the two forces is 240°.

$$\therefore R = \sqrt{10^2 + 15^2 + 2 \times 10 \times 15 \cos 240°} = \sqrt{175} = 13{\cdot}2.$$

If the angle between the two forces is 90°, the parallelogram becomes a rectangle, and the resultant, as before, can be found either by construction or by calculation.

Thus, $R = \sqrt{10^2 + 15^2} = \sqrt{325} = 18{\cdot}02$ units.

Laws of Motion.—It is necessary to read very carefully or, better, to commit to memory *Newton's Laws of Motion*. Of these, probably the second law is the most important. From the first law we obtain a definition of force as follows: *Force is that which changes, or tends to change, the state of rest or uniform motion of a body.*

The second law states that *change of motion is proportional to impressed force, and takes place in the direction in which the force is impressed.* The term "impulse" is now used instead of "impressed force," and we may say *the impulse of a force is measured by the change of momentum produced.* Thus the second law may be written: $Ft = M(V - v)$, ... (i)

where F is the force, t the time in seconds, M the mass of the body, v the initial velocity of the body, and V the final velocity.

The fundamental relation given by equation (i) between an impulsive force and the momentum it generates is of the utmost importance.

If the initial velocity be zero, or the body is at rest, then the relation becomes $Ft = MV$.

The change in the velocity for one second is $(V - v)$; this is called the acceleration, and may be denoted by f.

Hence from (i) we obtain $F = Mf$, ... (ii)

$$\text{or, } f = \frac{F}{M}.$$

$$\therefore \text{Acceleration} = \frac{\text{Force causing motion}}{\text{Mass moved}}.$$

This relation at once furnishes a measure of force—namely, the acceleration it will produce in a body of mass M.

It is an easy matter to verify (ii) by means of an Atwood's or other laboratory machine.

The fundamental equation $Ft = M(V - v)$ is often referred to as the *time equation of a force*; from it what is called the *energy* or *space equation* is readily obtained as follows:—

The space described by a body moving with uniform acceleration for a time t is the product of the average velocity and the time. If the initial velocity be v, and the final velocity V, then the average velocity is $\frac{1}{2}(V + v)$.

$$\therefore S = \tfrac{1}{2}(V + v)t, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(iv)}$$

where S denotes the space.

From (iv) we have $t = \dfrac{2S}{V + v}$.

Substituting this value of t in (1), we have $FS = \frac{1}{2}M(V^2 - v^2)$.

When the initial velocity is zero, this becomes $FS = \frac{1}{2}MV^2$.

Ex. 1. What is the connection between "impulsive force" and "momentum"?

A 1 oz. bullet strikes a block of wood with a velocity of 1500 feet per second, and has its momentum destroyed in a 1200th of a second. Determine the "impulse" of the force and the average resistance offered by the wood. (1900.)

Here the mass is 1 oz. $= \frac{1}{16}$lb., V = 1500, and $t = \frac{1}{1200}$.

Let F denote the average resistance of the wood.

$$\text{Then } F \times \frac{1}{1200} = \frac{1}{16} \times 1500.$$

$$\therefore F = \frac{1500 \times 1200}{16} = 112500 \text{ poundals.}$$

The impulse of the force is numerically equal to the momentum.

$$\therefore \text{impulse} = \frac{1}{16} \times 1500 \text{ foot poundals} = 93{\cdot}75 \text{ foot poundals}$$

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Ex. 2. A particle whose mass is 5 lbs. moves at the rate of 20 feet a second. Express its kinetic energy in foot poundals. If it moves over a distance of 30 feet against a constant resistance R, and its velocity is thereby reduced to 15 feet a second, find R in poundals. (1892.)

Kinetic energy $= \frac{1}{2}MV^2 = \frac{5}{2} \times 20^2 = 1000$ foot poundals.

From the equation $RS = \frac{1}{2}MV^2$ we have $R \times 30 = \frac{5}{2}(20^2 - 15^2)$ $= 437{\cdot}5$. $\therefore R = \frac{437{\cdot}5}{30} = 14\frac{7}{12}$ poundals.

Ex. 3. Give a description of Atwood's machine.

Two equal buckets, each weighing 3 lbs., are connected by a cord which passes over a smooth fixed pulley. They contain at first a 2 lb. weight and two 1 lb. weights respectively. If now one of the 1 lb. weights be removed, determine the motion and also the pressure on the pulley, and the tension of the cord. (1900.)

The total mass on each side is 5 lbs. When a 1 lb. weight is removed from one side, there remain 5 lbs. on one side and 4 lbs. on the other.

$$\therefore f = \frac{5-4}{9}g = \frac{1}{9}g.$$

Let T denote the tension in the string. On one side of the pulley the smaller mass is moving upwards, due to a tension T in the string, and the forces in action are therefore T upwards and 4 lbs. downwards, or force causing motion is $T - 4g$.

$$\therefore f = \frac{T - 4g}{4}.$$

On the other side of the pulley the forces are 5 lbs. downwards and T upwards.

$$\therefore f = \frac{5g - T}{5}.$$

Assuming that the length of the string connecting the two masses remains unaltered, then the acceleration of the mass on one side moving downwards is the same as the acceleration of the mass on the other side moving upwards. Hence

$$f = \frac{5g - T}{5} = \frac{T - 4g}{4}.$$

$$\therefore T = \frac{40}{9}g = 4\frac{4}{9}g.$$

Ex. 4. A particle whose mass is W moves from rest under the action of a force which does on it U units of work in a given time. What is its velocity at the end of that time?

Suppose the work done is 75 foot pounds ($g = 32$), and the mass of the body 27 lbs., what is its velocity?

Ans. $\sqrt{\left(\frac{2gU}{W}\right)}$; $13\frac{1}{3}$ ft. per sec.

Ex. 5. If R is the resultant of two forces, P and Q, acting at A, show that $R^2 = P^2 + Q^2 + 2PQ \cos PAQ$.

Two forces in the ratio of 1 to 3 have a certain resultant when their directions contain a certain angle; the square of the resultant is doubled if the direction of one of the forces is reversed. Find the angle, given $\sin 33^\circ 43' = \frac{5}{9}$.

Ex. 6. The mass of a body is m lbs., and its velocity v feet a second. Find the number of foot pounds of work it can do against a resistance.

A body weighs 10 lbs., and moves at the rate of 1250 feet a second. Find the distance through which it could overcome a resistance of one million pounds. (1888.)

Ans. ·244 feet.

Ex. 7. Two particles, whose masses are P and Q, are connected by a thread, which is placed on a smooth point. If P goes down and draws Q up, find the acceleration of its velocity.

Find the mass of P when twice the tension of the thread equals three times the weight of Q. (1891.)

Ans. P = 3Q.

Ex. 8. State Newton's Three Laws of Motion. Give his illustrations of the Third Law of Motion. (1894.)

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ELECTRICITY AND MAGNETISM.

NOTES ON ADVANCED AND HONOURS STAGE.

BY EDWIN EDSER, A.R.C.S., F.PH.S.

A GREAT many of the difficulties which beset the path of the student of advanced electricity and magnetism are due to a want of clearness in relation to the meaning of the fundamental terms of the science. The term "electro-motive force," for instance, often occasions considerable difficulty. At first sight no difficulty would be anticipated. The elementary student will at once say, "Mechanical force is that which moves matter, and electro-motive force moves electricity." So far all is clear. But the application of a force to matter continually increases the velocity of that matter, unless it is acted on by some form of frictional resistance. In the case of electricity it is quite different. The velocity of flow of electricity is quite independent of the electro-motive force applied. Hence, since the unit of mechanical force is defined as that which, acting on one gram of matter, will produce an acceleration of one centimetre per second in each second, students are often puzzled to give a clear meaning to the unit of electro-motive force. There are still other difficulties, such as the difference between electro-motive force (E.M.F.) and difference of potential or potential difference (P.D.). As any uncertainty in the meaning of these terms is calculated to seriously embarrass the student when engaged in the solution of problems involving these quantities, it has seemed worth while to devote a few pages to clearing the matter up as far as possible.

Difference of Potential (P.D.).—When electricity flows through a wire, the wire generally becomes heated. In some cases the heat generated may be considerable, as in the case where a platinum wire is rendered incandescent by causing a current to flow through it; but in all cases *some* heat is produced. Let Q be the quantity of heat produced per second in a given piece of wire when a current, C, flows through it. If Q is measured in terms of the quantity of heat necessary to raise 1 gram of water through 1° C., and if W is the amount of work (measured in ergs) which is equivalent to Q, then we have—

$$\frac{W}{Q} = 42 \times 10^6 = J \text{ (Joule's Law).}$$

$$\therefore W = 42 \times 10^6 \times Q \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1).$$

In words, we may say that whilst the current, C, flows through the wire, an amount of work equal to W ergs is performed during each second. The value of W becomes known directly that of Q has been determined. Q can be determined by immersing the wire in a calorimeter partly filled with a known mass of water (or better still, one of the liquid hydrocarbons), and observing the rise of temperature per second.

Let W, *the work equivalent to the heat produced per second in the wire, be divided by* C, *the current flowing through the wire; then the result is termed the potential difference* (P.D.) *between the ends of the wire.*

Writing E for the P.D. between the ends of a wire carrying a current, C, we have—

$$\frac{W}{C} = E. \qquad \therefore W = EC.$$

W is measured in ergs per second, and C is measured in terms of the electro-magnet unit of current. This latter, it should be remembered, is defined as follows:—

Unit current, flowing through 1 cm. of wire bent into an arc of a circle of 1 cm. radius, produces unit magnetic field at the centre of the circle.

If W′ is the work performed in t seconds, then

$$W' = Wt = ECt \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1).$$

It should be noticed that this expression does not embody a law, but is simply the consequence of our definition of E, the potential difference between the ends of the wire.

We further agree to the convention that the end of the wire at which the current enters is at a higher potential than the end at which it leaves. Thus, in passing along the wire in the direction in which the current flows, the potential falls; the difference of potential between any two points on it is numerically equal to the mechanical equivalent of the heat produced per second between those points, divided by the current flowing along the wire.

Resistance.—Observation shows that the P.D. between two points on a wire depends on the current flowing through the wire. For instance, when no current flows, the P.D. is obviously equal to zero. Increasing the current increases the P.D. Hence we may write—

$$E = aC + bC^2 + cC^3 + dC^4 + \ldots \quad . \quad . \quad . \quad (2),$$

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Ex. 2. A particle whose mass is 5 lbs. moves at the rate of 20 feet a second. Express its kinetic energy in foot poundals. If it moves over a distance of 30 feet against a constant resistance R, and its velocity is thereby reduced to 15 feet a second, find R in poundals. (1892.)

Kinetic energy $= \frac{1}{2}MV^2 = \frac{5}{2} \times 20^2 = 1000$ foot poundals.

From the equation $RS = \frac{1}{2}MV^2$ we have $R \times 30 = \frac{5}{2}(20^2 - 15^2)$ $= 437{\cdot}5$.

$$\therefore R = \frac{437{\cdot}5}{30} = 14\tfrac{7}{12} \text{ poundals.}$$

Ex. 3. Give a description of Atwood's machine.

Two equal buckets, each weighing 3 lbs., are connected by a cord which passes over a smooth fixed pulley. They contain at first a 2 lb. weight and two 1 lb. weights respectively. If now one of the 1 lb. weights be removed, determine the motion and also the pressure on the pulley, and the tension of the cord. (1900.)

The total mass on each side is 5 lbs. When a 1 lb. weight is removed from one side, there remain 5 lbs. on one side and 4 lbs. on the other.

$$\therefore f = \frac{5-4}{9}g = \frac{1}{9}g.$$

Let T denote the tension in the string. On one side of the pulley the smaller mass is moving upwards, due to a tension T in the string, and the forces in action are therefore T upwards and 4 lbs. downwards, or force causing motion is $T - 4g$.

$$\therefore f = \frac{T - 4g}{4}.$$

On the other side of the pulley the forces are 5 lbs. downwards and T upwards.

$$\therefore f = \frac{5g - T}{5}.$$

Assuming that the length of the string connecting the two masses remains unaltered, then the acceleration of the mass on one side moving downwards is the same as the acceleration of the mass on the other side moving upwards. Hence

$$f = \frac{5g - T}{5} = \frac{T - 4g}{4}.$$

$$\therefore T = \frac{40}{9}g = 4\frac{4}{9}g.$$

Ex. 4. A particle whose mass is W moves from rest under the action of a force which does on it U units of work in a given time. What is its velocity at the end of that time?

Suppose the work done is 75 foot pounds ($g = 32$), and the mass of the body 27 lbs., what is its velocity?

Ans. $\sqrt{\left(\frac{2gU}{W}\right)}$; $13\frac{1}{3}$ ft. per sec.

Ex. 5. If R is the resultant of two forces, P and Q, acting at A, show that $R^2 = P^2 + Q^2 + 2PQ \cos PAQ$.

Two forces in the ratio of 1 to 3 have a certain resultant when their directions contain a certain angle; the square of the resultant is doubled if the direction of one of the forces is reversed. Find the angle, given $\sin 33° 43' = \frac{1}{3}$.

Ex. 6. The mass of a body is m lbs., and its velocity v feet a second. Find the number of foot pounds of work it can do against a resistance.

A body weighs 10 lbs., and moves at the rate of 1250 feet a second. Find the distance through which it could overcome a resistance of one million pounds. (1888.)

Ans. ·244 feet.

Ex. 7. Two particles, whose masses are P and Q, are connected by a thread, which is placed on a smooth point. If P goes down and draws Q up, find the acceleration of its velocity.

Find the mass of P when twice the tension of the thread equals three times the weight of Q. (1891.)

Ans. $P = 3Q$.

Ex. 8. State Newton's Three Laws of Motion. Give his illustrations of the Third Law of Motion. (1894.)

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ELECTRICITY AND MAGNETISM.

NOTES ON ADVANCED AND HONOURS STAGE.

BY EDWIN EDSER, A.R.C.S., F.PH.S.

A GREAT many of the difficulties which beset the path of the student of advanced electricity and magnetism are due to a want of clearness in relation to the meaning of the fundamental terms of the science. The term "electro-motive force," for instance, often occasions considerable difficulty. At first sight no difficulty would be anticipated. The elementary student will at once say, "Mechanical force is that which moves matter, and electro-motive force moves electricity." So far all is clear. But the application of a force to matter continually increases the velocity of that matter, unless it is acted on by some form of frictional resistance. In the case of electricity it is quite different. The velocity of flow of electricity is quite independent of the electro-motive force applied. Hence, since the unit of mechanical force is defined as that which, acting on one gram of matter, will produce an acceleration of one centimetre per second in each second, students are often puzzled to give a clear meaning to the unit of electro-motive force. There are still other difficulties, such as the difference between electro-motive force (E.M.F.) and difference of potential or potential difference (P.D.). As any uncertainty in the meaning of these terms is calculated to seriously embarrass the student when engaged in the solution of problems involving these quantities, it has seemed worth while to devote a few pages to clearing the matter up as far as possible.

Difference of Potential (P.D.).—When electricity flows through a wire, the wire generally becomes heated. In some cases the heat generated may be considerable, as in the case where a platinum wire is rendered incandescent by causing a current to flow through it; but in all cases *some* heat is produced. Let Q be the quantity of heat produced per second in a given piece of wire when a current, C, flows through it. If Q is measured in terms of the quantity of heat necessary to raise 1 gram of water through 1° C., and if W is the amount of work (measured in ergs) which is equivalent to Q, then we have—

$$\frac{W}{Q} = 42 \times 10^6 = J \text{ (Joule's Law).}$$

$$\therefore W = 42 \times 10^6 \times Q \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1).$$

In words, we may say that whilst the current, C, flows through the wire, an amount of work equal to W ergs is performed during each second. The value of W becomes known directly that of Q has been determined. Q can be determined by immersing the wire in a calorimeter partly filled with a known mass of water (or better still, one of the liquid hydrocarbons), and observing the rise of temperature per second.

Let W, *the work equivalent to the heat produced per second in the wire, be divided by* C, *the current flowing through the wire; then the result is termed the potential difference* (P.D.) *between the ends of the wire.*

Writing E for the P.D. between the ends of a wire carrying a current, C, we have—

$$\frac{W}{C} = E. \qquad \therefore W = EC.$$

W is measured in ergs per second, and C is measured in terms of the electro-magnet unit of current. This latter, it should be remembered, is defined as follows:—

Unit current, flowing through 1 cm. of wire bent into an arc of a circle of 1 cm. radius, produces unit magnetic field at the centre of the circle.

If W′ is the work performed in t seconds, then

$$W' = Wt = ECt \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1).$$

It should be noticed that this expression does not embody a law, but is simply the consequence of our definition of E, the potential difference between the ends of the wire.

We further agree to the convention that the end of the wire at which the current enters is at a higher potential than the end at which it leaves. Thus, in passing along the wire in the direction in which the current flows, the potential falls; the difference of potential between any two points on it is numerically equal to the mechanical equivalent of the heat produced per second between those points, divided by the current flowing along the wire.

Resistance.—Observation shows that the P.D. between two points on a wire depends on the current flowing through the wire. For instance, when no current flows, the P.D. is obviously equal to zero. Increasing the current increases the P.D. Hence we may write—

$$E = aC + bC^2 + cC^3 + dC^4 + \ldots\ldots \quad . \quad . \quad . \quad (2),$$

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where a, b, c, d are constants whose values must be determined experimentally. The meaning of this equation should now be carefully considered. We may suppose that various values of E, corresponding to definite values of C, have been observed. Then the relation between E and C may be expressed by a curve, of which the abscissæ are the observed values of C, and the ordinates are the corresponding values of E. If we substitute any particular numerical value of C and the corresponding numerical value of E in (2), we shall obtain an equation involving only definite numbers, and the unknown constants a, b, c, d, etc. . If we repeat this operation, substituting different values of C and the corresponding values of E obtained from the curve above alluded to, we shall obtain a number of simultaneous equations in a, b, c, d, etc., and from these the numerical values of a, b, c, d, etc., can be calculated. Substituting these values in (2), we obtain an equation which shows us exactly how E varies with C. From this, given any numerical value of C, we can at once determine the corresponding value of E. Thus (2) is merely an analytical expression of the law connecting E and C, and can be used instead of the curve alluded to above.

Ohm's Law.—Proceeding in a manner which differed only in details from that indicated above, Ohm found that, provided the temperature of the wire remained constant,

$$b = 0,\ c = 0,\ d = 0,\ e = 0, \text{ etc.},$$

so that $$E = aC \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3).$$

Hence the form of the curve mentioned above will be a straight line passing through the origin of co-ordinates, and inclined to the axis of C at an angle of which the tangent is equal to a.

A particular name is given to the constant a. It is termed the *resistance* of the wire. This is generally denoted by the letter R. Substituting R for a in (3), we get—

$$E = RC \quad \text{(Ohm's Law)} \quad . \quad . \quad . \quad . \quad . \quad . \quad (4).$$

$$\therefore \frac{E}{R} = C,$$

$$\text{and } \frac{E}{C} = R.$$

$$\text{But } W' = EC\mathit{t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{from (1).}$$

$$\therefore W' = CR \times C\mathit{t} = C^2R\mathit{t} = E \times \frac{E}{R}\mathit{t} = \frac{E^2}{R}\mathit{t} \quad . \quad . \quad . \quad . \quad \text{from (4).}$$

C.G.S. Units and Practical Units.—The units derived in the manner explained above possess magnitudes which in some cases are inconveniently large, and in other cases are inconveniently small. For this reason certain practical units have been derived from them.

Practical unit of P.D. = the volt = 100,000,000, (or 10^8) C.G.S. units of P.D.

" " " *Current* = the ampère = $\frac{1}{10}$, (or 10^{-1}) C.G.S. units of current.

" " " *Resistance* = the ohm = 1,000,000,000 (or 10^9) C.G.S. units of resistance.

Electro-Motive Force.—In passing once completely round a closed circuit along which a current is flowing, the potential will either decrease or increase, according as we follow the direction of the current or not. The total fall of potential, starting from any point in a closed circuit, and returning to the same point after traversing the circuit in the direction of the current, is equal to the electro-motive force (E.M.F.) in the circuit.

A few problems necessitating the use of the laws developed above will now be given.

Problem.—Two wires, of 3 and 7 ohms respectively, are connected in series with the terminals of a battery of 5 ohms internal resistance, and an E.M.F. of 10 volts. How much heat is generated per second in the battery, and how much in each of the wires?

Answer.—To find the current in the circuit, we must divide the E.M.F. (10 volts) by the total resistance of the circuit. Since the wires are connected in series with the battery, the total resistance of the circuit = 5 + 3 + 7 = 15 ohms.

$\therefore$ Current in circuit = $\frac{10}{15}$ = ·67 ampères (nearly).

But work done in conductor = (current)^2 × (resistance), if current and resistance are measured in C.G.S. units.

$\therefore$ Work done in battery

$$= (\cdot 67 \times 10^{-1})^2 \times (5 \times 10^9) \text{ ergs}$$
$$= \cdot 00449 \times 5 \times 10^9$$
$$= 2 \cdot 24 \times 10^7 \text{ ergs.}$$

$\therefore$ Heat generated per second in battery

$$= \frac{2 \cdot 24 \times 10^7}{42 \times 10^6} \text{ heat units}$$
$$= \cdot 53 \text{ heat unit per sec.}$$

Work done per second in wire of 7 ohms resistance

$$= (\cdot 67 \times 10^{-1})^2 \times (7 \times 10^9)$$
$$= 3 \cdot 14 \times 10^7 \text{ ergs.}$$

$\therefore$ Heat generated in this wire

$$= \frac{3 \cdot 14 \times 10^7}{42 \times 10^6} = \cdot 75 \text{ heat unit per sec.}$$

Similarly, heat generated in wire of 3 ohms resistance

$$= \cdot 32 \text{ heat unit per sec.}$$

Notice that in this case, since the same current flows through each wire, more heat is generated in the high than in the low resistance wire. In fact, the heat generated is in this case proportional to the resistance of the part of the circuit considered.

Problem.—A circuit consists of (*a*) a battery of E.M.F. = 10 volts, and internal resistance = 2 ohms; and (*b*) two wires, of resistance 1 and 2 ohms respectively, connected in parallel with the terminals of the battery. How much heat is generated per second in the battery, and in each of the wires?

Answer.—Conductivity of external circuit

$$= \frac{1}{1} + \frac{1}{2} = 1 \cdot 5.$$

$\therefore$ Resistance of external circuit

$$= \frac{1}{1 \cdot 5} = \cdot 67 \text{ ohm (nearly).}$$

$\therefore$ Total resistance of circuit

$$= 2 + \cdot 67 = 2 \cdot 67 \text{ ohms.}$$

Current flowing through battery

$$= \frac{10}{2 \cdot 67} = 3 \cdot 7 \text{ ampères.}$$

$\therefore$ Work performed per second in battery

$$= (3 \cdot 7 \times 10^{-1})^2 \times (2 \times 10^9) \text{ ergs}$$
$$= 2 \cdot 74 \times 10^8 \text{ ergs.}$$

$\therefore$ Heat generated in battery

$$= \frac{2 \cdot 74 \times 10^8}{42 \times 10^6} = 6 \cdot 5 \text{ heat units per sec.}$$

The current of 3·7 ampères which flows through the battery distributes itself in the wires in a ratio inversely proportional to their respective resistances. Hence

Current in wire of 1 ohm resistance

$$= \frac{2}{1+2} \times 3 \cdot 7 = 2 \cdot 46 \text{ amp.}$$

Current in wire of 2 ohms resistance

$$= \frac{1}{1+2} \times 3 \cdot 7 = 1 \cdot 23 \text{ amp.}$$

$\therefore$ Heat generated in wire of 1 ohm resistance

$$= \frac{(2 \cdot 46 \times 10^{-1})^2 \times (1 \times 10^9)}{42 \times 10^6} = \frac{60 \cdot 5 \times 10^6}{42 \times 10^6}$$
$$= 1 \cdot 44 \text{ heat units per sec.}$$

Heat generated in wire of 2 ohms resistance

$$= \frac{(1 \cdot 23 \times 10^{-1}) \times (2 \times 10^9)}{42 \times 10^6} = \frac{30 \cdot 2 \times 10^6}{42 \times 10^6}$$
$$= \cdot 72 \text{ heat unit per sec.}$$

Note that in this case the greater amount of heat is generated in the wire of smaller resistance.

SCIENCE NOTES.

Oxygen and the Germination of Seeds.—M. P. Mazé has recently conducted some interesting experiments on the germination of seeds immersed in water, and the part played in it by oxygen. The seeds were placed in sterilised water, and varying quantities of oxygen gas were added. He thinks that seeds when submerged in a liquid do not germinate, for lack of aëration. When they are placed under water, though life appears to remain in a latent condition, the seeds are the seat of various diastatic changes. The hydrolysing enzymes particularly, and zymase, preserve their activity, as seeds do that germinate under ordinary conditions. But the oxidising enzymes cannot produce in the body of a liquid the oxidising processes that the elaboration of reserve food material requires; consequently the embryos of the young seedlings remain inert. Small seeds, such as those of cruciferous plants, are able to develop slowly, because an atmosphere within their coats provides oxygen necessary for respiration. Starchy seeds rapidly lose the power of germinating when under water; oily seeds are more resistant, though there is no proof that any kind of seed can long resist this treatment.

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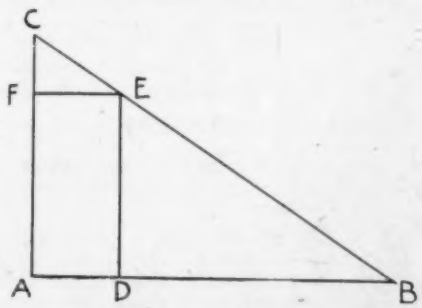
E. J. Browne.—The terminals of a battery, of E.M.F. 4 volts, and resistance 3 ohms, are connected by a wire of resistance 9 ohms. By how much is their difference of potential altered thereby? (Science and Art, Advanced Elec. and Mag., 1900.)

$$\text{Current flowing round circuit} = \frac{4}{3+9} = \frac{1}{3} \text{ ampère.}$$

When this current flows through the wire of resistance 9 ohms, the difference of potential between its ends $= 9 \times \frac{1}{3} = 3$ volts. (See Notes on Electricity and Magnetism in current number.)

$\therefore$ alteration in P.D. between terminals due to introduction of the above wire $= 4 - 3 = 1$ volt.

A graphical solution of this problem is given in the accompanying diagram. Resistances are plotted horizontally, and voltage (in a scale twice as great) vertically. AD = 3, DB = 9. $\therefore$ AB = 12. AC = 4 volts. Thus the potential falls



from 4 at A to 0 at B, as indicated by the straight line CB. Draw DE vertically, and FE parallel to AB. Then DE represents the potential at D, on the same scale as the E.M.F. of the cell is represented by AC. Hence fall of potential between terminals of battery, due to joining the latter by a wire of 9 ohms, = CF.

By similar triangles $\frac{CF}{FB} = \frac{CA}{AB}$.

$\therefore \frac{CF}{3} = \frac{4}{12}$. $\therefore$ CF = 1.

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Theta.—Search shall be made for the original memoirs bearing upon these two somewhat obscure points, and a note shall appear in the Physiography section embodying recent discoveries concerning the matters in question.

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Khaki.—We are sorry that you find Catchpool's *Sound*, published by the U.C.C., too difficult for you. Although the standard aimed at is a little above that required for the Intermediate Science Examination (London), yet it is certainly the best book for your purpose. If you can get a copy of Tyndall's *Sound*, you will find it very entertaining reading, and it should cover most of the syllabus. You might also try the section on Sound in Deschanel's *Physics*.

It is impossible for us to give you any idea of the amount of reading you would require for the Honours Chemistry in Intermediate Science, unless we knew something of the present state of your knowledge in that subject. The standard is very much higher than that required for the pass examination.

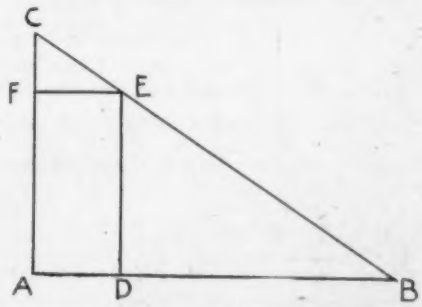
E. J. Browne.—The terminals of a battery, of E.M.F. 4 volts, and resistance 3 ohms, are connected by a wire of resistance 9 ohms. By how much is their difference of potential altered thereby? (Science and Art, Advanced Elec. and Mag., 1900.)

$$\text{Current flowing round circuit} = \frac{4}{3+9} = \frac{1}{3} \text{ ampère.}$$

When this current flows through the wire of resistance 9 ohms, the difference of potential between its ends $= 9 \times \frac{1}{3} = 3$ volts. (See Notes on Electricity and Magnetism in current number.)

$\therefore$ alteration in P.D. between terminals due to introduction of the above wire $= 4 - 3 = 1$ volt.

A graphical solution of this problem is given in the accompanying diagram. Resistances are plotted horizontally, and voltage (in a scale twice as great) vertically. AD = 3, DB = 9. $\therefore$ AB = 12. AC = 4 volts. Thus the potential falls



from 4 at A to 0 at B, as indicated by the straight line CB. Draw DE vertically, and FE parallel to AB. Then DE represents the potential at D, on the same scale as the E.M.F. of the cell is represented by AC. Hence fall of potential between terminals of battery, due to joining the latter by a wire of 9 ohms, = CF.

By similar triangles $\frac{CF}{FB} = \frac{CA}{AB}$.

$\therefore \frac{CF}{3} = \frac{4}{12}$. $\therefore$ CF = 1.

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OUR COMPETITION PAGE

OUR FRENCH PRIZE COMPETITION.

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WE should like to specially direct the attention of our readers to the fact that the Board of Education, in the Syllabuses for the Scholarship and Certificate Examinations 1901, requires "no set books" for French and German. Students preparing for these examinations, as well as students for London Matriculation, could not do better than attempt month by month the pieces set for translation here. They are from the best authors, and of varied character. A competitor who does not gain a prize can derive considerable benefit from the exercise. A study of the successful competitor's translation, and of our remarks, will help him to see where he might have done better. If desired, his paper can be returned (fully corrected) by enclosing six stamps.—ED.

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1. All translations should be **posted not later than October 8,** and addressed:—*Prize Editor*, Office of THE PRACTICAL TEACHER, 33 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.
3. Competitors should adopt a pseudonym, and send name and address written on a separate piece of paper.
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A Prize of One Guinea will be given for the best translation into English of the following extract:—

Cependant Antioche était en proie à la disette qui avait si longtemps désolé les croisés, et voyait chaque jour diminuer le nombre de ses défenseurs. Accien demanda une trêve et promit de se rendre, s'il n'était bientôt secouru. Les croisés, toujours pleins d'une confiance aveugle, consentirent à une paix qui devait leur ôter tous leurs avantages et donner à l'ennemi le moyen de gagner du temps et de réparer ses forces. Les assiégés avaient profité de la trêve pour se procurer les secours et les vivres nécessaires. Les chrétiens ne déployèrent au pied des murs qu'une valeur impuissante, et la ville, après sept mois de siège, pouvait braver encore longtemps la force de leurs armes, si l'ambition et la ruse n'avaient fait pour la cause des croisés ce que n'avaient pu faire la patience et la bravoure. Bohémond, que le désir d'accroître sa fortune avait entraîné à la croisade, cherchait partout l'occasion de réaliser ses projets. La fortune de Baudouin avait éveillé sa jalousie et le poursuivait dans son sommeil. Il osa jeter ses vues sur Antioche, et les circonstances le favorisèrent assez pour lui faire rencontrer un homme qui pût remettre cette place entre ses mains. Cet homme, qui se nommait Phirous, était, quoi qu'en disent plusieurs historiens qui lui donnent une noble origine, le fils d'un Arménien, fabricant de cuirasses. D'un caractère inquiet et remuant, il aspirait sans cesse à changer de condition et d'état. Il avait abjuré la religion chrétienne par esprit d'inconstance et dans l'espoir d'avancer sa fortune; il était doué d'un sang-froid admirable, d'une audace à toute épreuve, et toujours prêt à faire pour de l'argent ce qu'on pouvait à peine attendre du plus ardent fanatisme. MICHAUD.

RESULT OF THE AUGUST COMPETITION.

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Second Class.—Credo, Try again (Kelso), Concours, Helen of Troy, Automobile, San Toy, Tain, Marie I., L.E.K.P., Jean, Dunelm, Kitchener, Essayer, Borealis, Try again (Orphis), Mair, Brica, Hamlet, Moloch, Bristoliensis, Freedom, Ixia, Macaulay, Abigail, Commentator, Aberystwyth, Morganwg, Mercia (Crewkerne), Jeanne d'Arc, Competitor, Dier Nodrog, Discipulus, Lehte, S.A.B., Romanesque, Botanica.

Third Class.—East Riding, Mercia (Hitchin), Navy Blue.

Disqualified, Rule 3: Staley.

Report.

The piece did not present any special difficulties, and, as a result, a large number of the candidates are in the First Class. Of these a very fair proportion have sent in really creditable papers. *Trou de serrure* puzzled some candidates, who translated it as "hole in a lock" instead of as the familiar "keyhole." One candidate translated it as "careful words." Half a dozen could not resist the temptation of linking *clos* with *derrière* as "close behind." If the editor had intentionally set a trap for the unwary candidate, he could hardly have devised a better one. *Séparés comme ils le sont*, etc., was rendered by one candidate, "separated as man is from all connection with the other parties concerned;" and another translates *en esprits subtils* as "being in keen spirits." *Séparent trop de la cour divine* figures as "the separate excess of the divine court," and *certains de l'action funeste qu'ils ne pourront manquer d'avoir* as "which neither died nor failed in their fatal results." These extracts are sufficient to show that even a Prize Editor has his trials.

French Prize Translation.

There is a legend in the Koran which we have always thought very striking. The demons are prowling round Paradise, and trying to intrude themselves within it by stratagem. They lie in wait, they wriggle and creep, they spy out every chance. Here, one peeps through a keyhole; there, one claps his ear to a door-chink; here, another leans his head against a closed shutter behind which he hears music—that of the voices of the angels talking together. But the chinks and the keyholes afford them only a slight glimpse of the heavenly glories, while doors and shutters form too effectual a barrier between them and the Court of the Holy to allow of their hearing any connected conversations. Accordingly they catch but isolated words, scraps of sentences without proper beginning or end, and in spite of all their efforts they can catch nothing more. Back, however, they come with this store of fragmentary speech, and, like the subtle spirits that they are, scatter these odds and ends of sentences among mankind, sure of the fatal effect which they cannot and will not fail to have, severed as they are from all connection with the other parts of the discourse to which they refer. The result foreseen by the demons is realised: these words are eagerly accepted by mankind, who recognise in them a supernatural element; but inasmuch as they are always perforce misinterpreted, they have consequences that are actually demoniacal, although they are of angelic origin. This legend is something more than a symbol; it is the true, authentic account of the origin and destinies of the superstitions embodied in the history of the human race.

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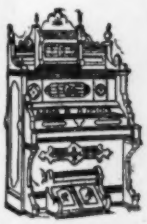

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